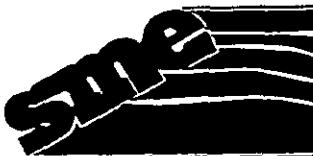


M6 SPS-6



soil and materials engineers, inc.

43980 Plymouth Oaks Blvd Plymouth, MI 48170-2584 (313) 454-9900 FAX (313) 454-0629

Kenneth W Kramer PE
Frank A Henderson, PG
Gerald M Belian PE
Garrett H Evans PE
Larry P Jedeik PE
Starr D Kohn PhD PE
Edward S Lindow PE
Robert C Rabeler, PE
Robert E Zayko, PE

Timothy H Bedenik PE
J William Cobert CET
Chuck A Gemayel PE
Cheryl Kehres-Dietrich CGWP
Gerard P Madej PE
Sheryl K Fountain
Michael E Gase CWI
Julie A Hartner
Cary T Keller PE
Truman F Maxwell CPA
Michael S Meddock, PE
Timothy J Mitchell PE
Thomas M Powell
John C Zarzecki CWI

June 17, 1996

Mr Richard E. Ingberg, P.E.
Regional Engineer, North Central FHWA - LTPP
c/o Braun Intertec Inc.
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108

Re: Missouri SPS-6 Construction Report
FHWA - LTPP
SME Project No PP18400

Dear Mr Ingberg

Enclosed please find three copies of the construction report for the Missouri SPS-6 project.

Should you have any questions concerning this report, please contact our office.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Cary T Keller, P E
Senior Engineer

Enclosure Construction Report Missouri SPS-6 (3 copies)

pc Erland Lukanan, Braun Intertec
Monte Symons, FHWA LTPP
William Trimm, Missouri Highway & Transportation Dept

FEDERAL HIGHWAY ADMINISTRATION
Long Term Pavement Performance
Specific Pavement Studies

CONSTRUCTION REPORT FOR SPS-6
290600

Missouri Highway and Transportation Department
Project Number: F.A.-35-2(60) Sec. A&B
Job Number 1I-507-35

IH-35 SB, Harrison County, MO
Constructed in 1992

Report Prepared by
Soil and Materials Engineers, Inc
FHWA-LTPP North Central Region
December 1995



1.0 INTRODUCTION

The SHRP experimental project SPS-6 "Rehabilitation of Jointed Portland Cement Concrete (PCC) Pavements" investigates the effects of different types and amounts of rehabilitation on long term pavement performance for rigid pavements. In this experiment, eight test sections were constructed with varying types and degrees of pavement surface rehabilitation, varying flexible pavement overlay thicknesses, with or without pavement drainage. The SPS-6 project was constructed using the construction guidelines contained in the document "Specific Pavement Studies: Construction Guidelines for Experiment SPS-6, Rehabilitation of Jointed Portland Cement Concrete Pavements", Operational Memorandum Number-SHRP-LTPP-OM-013 (July 1990).

The Missouri SPS-6 project was constructed as part of the reconstruction of I-35, a four lane divided highway, in 1992. The project is located in Harrison County, south of Bethany, Missouri. The location of the project in the state is shown in Figure 1. The project was open to traffic in the fall of 1992.

The existing PCC pavement is subjected to four different levels of rehabilitation including:

- 1) Overlay with minimal surface preparation sections.
- 2.) Overlay with Intensive surface preparation sections
- 3) Overlay with Crack/break and seat sections
- 4) Overlay with Saw and Seal sections.

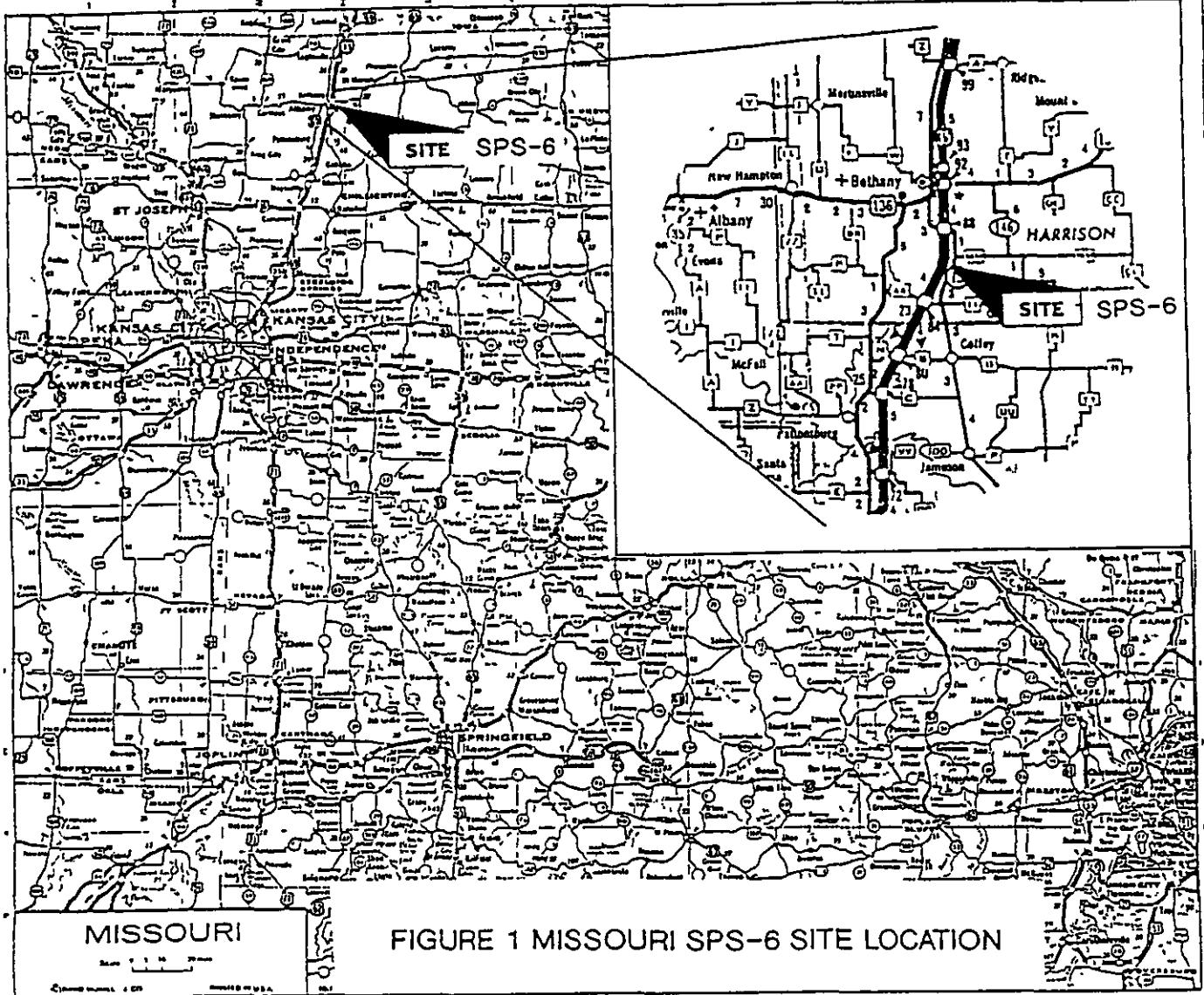
A routine maintenance (control) section with no overlay, MHTD Project typical and MHTD Special Rehabilitation were included for comparison purposes. In addition, MHTD Supplemental Sections were constructed as identical counterparts to the SHRP Crack/Break and Seat sections, with opposing drainage characteristics. A total of four (4) rubblized sections were also included with two separate overlay thicknesses and opposing drainage characteristics

The work plan for the project produced by the MHTD Research Section and dated February 1992, provides more information concerning the project and was referenced for this report.

2.0 PROJECT DESCRIPTION

The Missouri SPS-6 experiment is located on IH-35 in Harrison County south of Bethany, Mo. as shown in Figure 1. This project falls into the experimental cell for jointed reinforced PCC pavements on fine grained soils in the wet-freeze environmental zone. The test sections are located along southbound IH-35. The existing pavement section consisted of two 12' lanes of 9 inch PCC with a 61 5 ft contraction joint spacing. The outside shoulder is asphalt concrete surface treated, for a total width of 10 feet. Contraction joints are perpendicular with the direction of traffic. The test sections are located on a rolling terrain. The PCC was placed on a polyethylene vapor barrier and 4 inches of aggregate base, which was placed directly on natural subgrade or embankment fill. Project soil borings typically





describe the subgrade as brown sandy clay. Traffic volumes reported in the nomination documents for the year 1991 were as follows

Table 1 Traffic Data

Annual Average Daily Traffic (Two Direction)	9771
Percent heavy trucks and Combination (of AADT)	24%
Count year of AADT Estimate	1990
Estimated 18Kip ESAL application in study lane	426,000/yr

The predominate pavement distress necessitating rehabilitation was reported as durability cracking. However pre-construction distress surveys also indicated joint faulting, joint seal damage, transverse cracking and pumping at various locations. The pavement was assessed to be in fair condition. Most of the test sections were located to avoid cut/fill transitions. However, section 290607 was located predominately in a cut, with the first 150 ft in a fill area. In addition, MHTD supplemental section 290663 has two culverts located within the section. The drainage culverts are 18 inches and 48 inches in diameter, located 6 ft. and 17 ft. below top of embankment, respectively. During the nomination phase of this project, no visible distress was observed associated with the culverts.

3.0 PROJECT DETAILS

The site layout for the Missouri SPS-6 experiment is shown in Figure 2. Beginning and ending stations shown indicate the lengths of each test section and transition sections. Table 2 summarizes the work performed for each section.

Table 2 Section Description

STATION	SHRP ID	SURFACE PREPARATION	OVERLAY THICKNESS
1394+00 to 1400+00	290607	CRACK/BREAK AND SEAT GEOCOMPOSITE EDGE DRAINS	4 IN
1418+50 to 1423+50	290659	CRACK/BREAK AND SEAT	4 IN
1429+00 to 1434+00	290660	CRACK/BREAK AND SEAT SHOULDERS WIDENED	8 IN
1435+50 to 1440+50	290608	CRACK/BREAK AND SEAT GEOCOMPOSITE EDGE DRAIN SHOULDERS WIDENED	8 IN



FIGURE 2

MISSOURI SPS-6 PROJECT

I-35 SOUTHBOUND

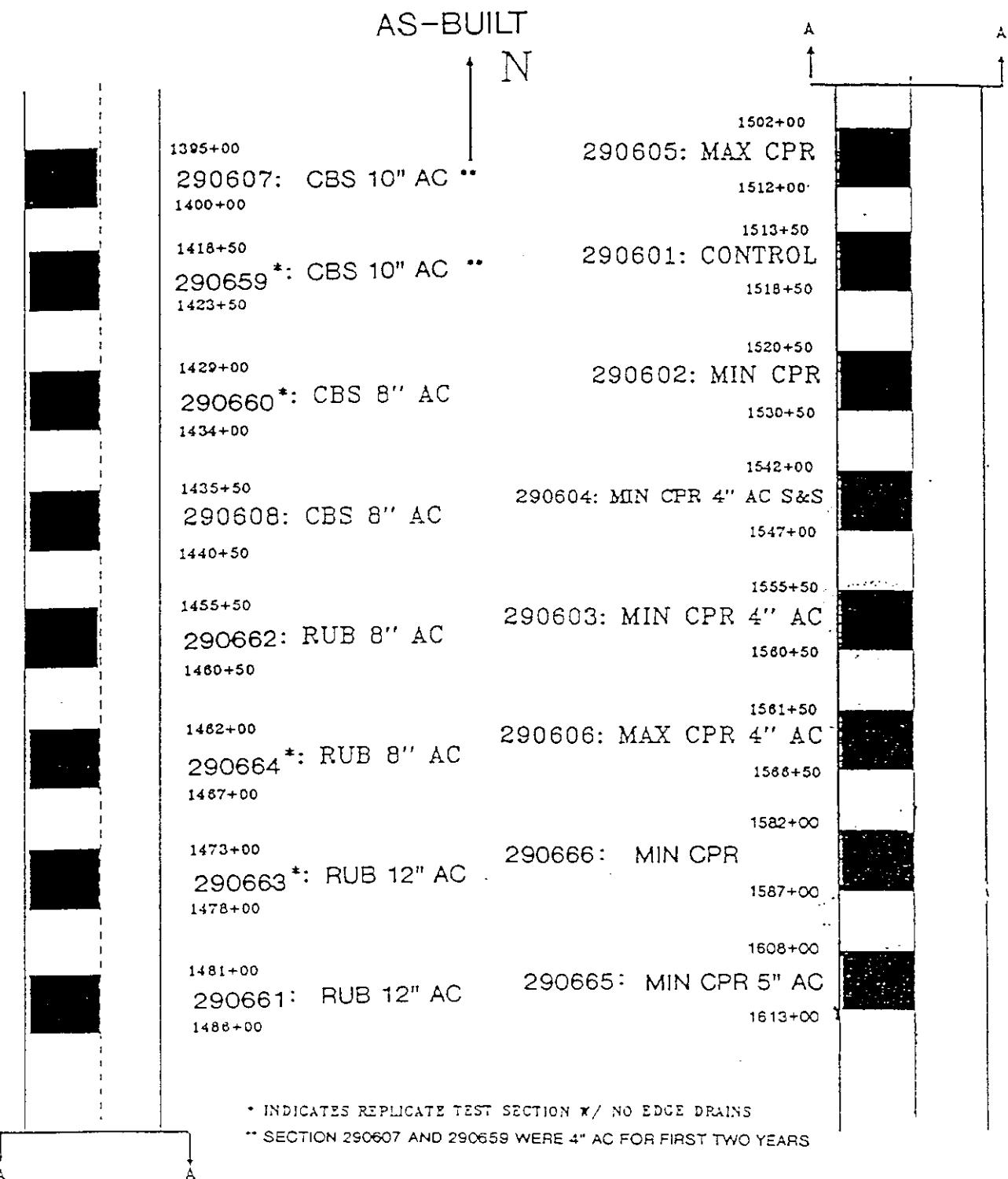


Table 3 Surface Preparation

Section No.	Joint Grouting Total (ft.)	Crack Sealant Total (ft.)	Decomposi- tion Depth Y/N	Pull-Off/ Repair (PCC) Slabs Total (sq. ft.)	Pull-Off/ Repair (PCC) Slab & Base Total (sq. ft.)	Diamond Grinding Y/N	Undercutting Y/N
290601	N/A	N/A	N/A	N/A	N/A	N/A	N/A
290602	263	0	NONE	804	408	YES	NONE
290603	0	0	NONE	360	384	NO	NONE
290604	0	0	0	528	0	NO	NONE
290605	1897	12	YES	1416	660	YES	YES
290606	0	0	YES	360	552	NO	YES
290607	N/A	N/A	YES	0	0	N/A	N/A
290608	N/A	N/A	YES	0	0	N/A	N/A

4.0 CONSTRUCTION

4.1 Key Personnel

Personnel from the North Central Region were involved in the nomination, site layout, pre-construction material sampling and testing, construction monitoring and post-construction material sampling and testing. Bruce Loesch, SHRP contact for the MHTD, represented the MHTD during all phases of the project. The following is a list of the key personnel, contractors and agencies involved in the various phases of the project:

Missouri Highway and Transportation Department-SHRP Coordinating Contacts

William Trimm
Bruce Loesch

Missouri Department of Transportation
Materials and Research Division Central Laboratory
P.O. Box 270
Jefferson City, MO 65102
(314) 751-2551
(314) 751-6551 FAX

Missouri Highway and Transportation Department-Project Specific

Dwayne Cooly-Resident Engineer

Missouri Highway and Transportation Department
311 N Walnut



311 N. Walnut
P O. Box 272
Cameron, MO 64429

FHWA-LTPP North Central Region Coordination Office

Richard Ingberg-Regional Engineer

FHWA-LTPP North Central Region
6875 Washington Avenue South
P.O Box 39108
Minneapolis, MN 55439-0108
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Gene Skok

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Starr Kohn
Chuck Gemayel
Cary Keller
Eric Huff

Soil and Materials Engineers
43980 Plymouth Oaks Blvd
Plymouth, MI 48170
(313) 454-9900
(313) 454-0629 FAX

Contractor Information

Chester Bross Construction Co
General Contractor



4.2 Paving Operations

Placement of asphalt concrete began at the northern most section and proceeded in a north to south direction. The paving operation began on July 10, 1992, and ended on August 10, 1992. Three rollers, were used for compaction: (1) Breakdown rolling was performed using a double drum vibratory roller; (2) Intermediate rolling utilized a Pneumatic Tired Roller; and (3) Final rolling utilized a steel wheel tandem roller. Table 4 summarizes the results of construction quality control tests. Asphalt cement concrete mix design information is contained in Appendix E.

Table 4 Asphalt Quality Control Test Results

SECTION	MAXIMUM DENSITY (LBS/FT. ³) WEARING	MAXIMUM DENSITY (LBS/FT. ³) BINDER	AVERAGE DENSITY (LBS/FT. ³) WEARING	AVERAGE DENSITY (LBS/FT. ³) BINDER	MEAN LAYDOWN TEMP (F) WEARING	MEAN LAYDOWN TEMP (F) BINDER
290603	148.4	149.3	145.8	146.3	300	278
290604	148.4	149.3	145.3	148.5	300	280
290606	148.4	149.3	145.7	144.2	300	273
290607	148.4	149.3	144.3	146.4	300	270
290608	148.4	149.3	145.7	147.7	300	278

4.3 Construction Deviations

The following is a list of known deviations from the site location, construction, and data collection and materials sampling and testing guidelines. The project was designed under the SPS-6 Construction Guidelines dated July 1990. Construction problems which may impact the performance of the sections and are not covered by SHRP documents are discussed in this section.

- A. Section 290607 (Crack/Break and Seat) is located on a vertical curve and during the Crack/Break operation, the broken slabs were displaced down the grade several feet and toward the outside shoulder several inches. It is believed that the Polyethylene vapor barrier acted as a slip plane during the Crack/break operation. A guillotine drop hammer was used for this operation.

Note: Correspondence associated with section and premature maintenance activities is included in Appendix D.

- B. Section 290661 and 290663 (MHTD Supplementals) were rubblized prior to placement of the overlay. The original overlay thickness of 4 inches was increased to 12 inches due to poor support conditions of the rubblized pavement and underlying subgrade during asphalt paving activities.



4.4 Material Sampling and Testing

Pre and Post-Construction field material sampling and testing were performed in general accordance with the Specific Pavement Studies Material Sampling and Testing Guidelines Construction Guidelines for Experiment SPS-6 dated January, 1991. The results of these tests were sent to the NCRCO in Minneapolis, MN.

Table 5 is a summary of the as-built thicknesses of the main test sections obtained from the Construction Data Sheet 2 for each section (unless noted otherwise). The Portland cement concrete thickness were obtained from the pre-construction material sampling and testing activities. The asphalt concrete layer thicknesses are the averages obtained from field elevation profile surveying. Actual material layer thicknesses obtained from the post-construction sampling cores have been submitted to the NCRCO in Minneapolis, MN.

Table 5 Layer Descriptions (Inches)

Section NO.	Asphalt Wearing Course	Asphalt Binder Course	Total Asphalt Thickness	Portland Cement Concrete	Aggregate Base Layer
290601	N/A	N/A	N/A	9.2*	4.0*
290602	N/A	N/A	N/A	9.0*	4.0*
290603	1.7	2.1	3.8	9.0	4.0
290604	1.5	2.3	3.8	9.0	4.5
290605	N/A	N/A	N/A	9.4*	4.0*
290606	1.5	2.1	3.6	8.9	3.5
290607	1.8	2.5	4.3	9.2	4.1
290608	2.3	5.6	7.9	9.2	5.3

*These thicknesses are averages obtained from the site verification sampling activities.

Pre and Post-construction material sampling and testing layouts are included in Appendix C

Pre construction, during construction and post construction falling weight deflectometer testing was performed by the Missouri Highway and Transportation Department-Materials and Research Division Central Laboratory (MHTD-MRDCL). Assistance with the SHRP testing protocols was provided by the NCRCO. Continued testing after construction has been performed by the MHTD-MRDCL with the exception of testing in 1995 which was performed by the NCRCO personnel and equipment.



5.0 TRAFFIC MONITORING

The MHTD has installed an IRD 1060 Piezoelectric system south of the project in Daviess County. This equipment was strategically located in association with the Missouri SPS-4B site located on IH-35 (northbound), approximately 30 miles south of the SPS-6 site. The information is supplemented by portable WIMs and traffic counting instrumentation utilized at intermediate points on a seasonal basis. The WIM information is submitted to the North Central Region Coordinating Office on a quarterly basis. Their traffic monitoring data collection satisfies the minimum requirements recommended by SHRP.

6.0 INITIAL PERFORMANCE

Some isolated pavement distress was observed in sections 290607 and 290609 approximately 1 year after construction. Alligator (fatigue) cracking followed by potholes were the primary distress, with some isolated thermal cracking also observed. Attached to this construction report are letters from the NCR Regional Engineer and the MHTD-LTPP Contact, summarizing their observations and recommendations. In addition, a copy of the MHTD Maintenance forms and pre-construction distress surveys. In general, full depth asphalt patches were performed and the sections were immediately overlaid with approximately 6 inches of asphalt cement concrete.

The remaining sections appeared to perform well, as observed 1 year after construction.

Distress surveys performed in 1995 indicated that some of the sections are experiencing some low severity thermal cracks. Routine maintenance, including full depth patching and shoulder repair was performed on the sections which were not overlaid. Complete distress surveys have been submitted to the NCRCO in Minneapolis, MN.

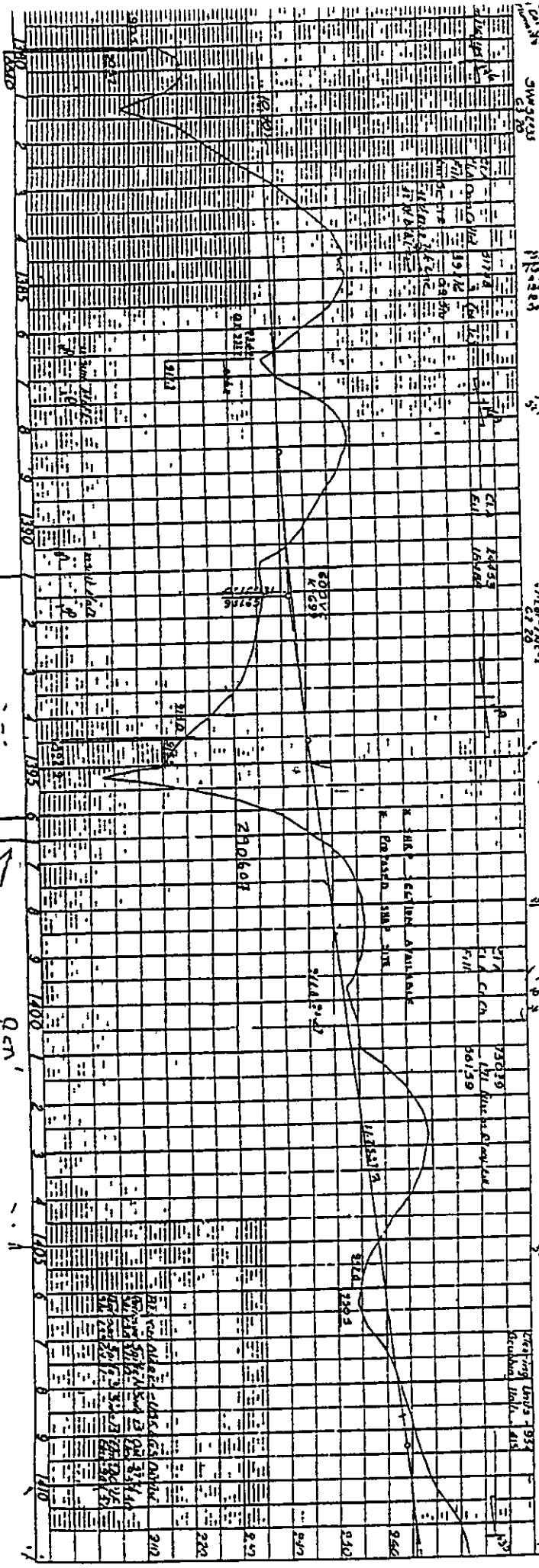
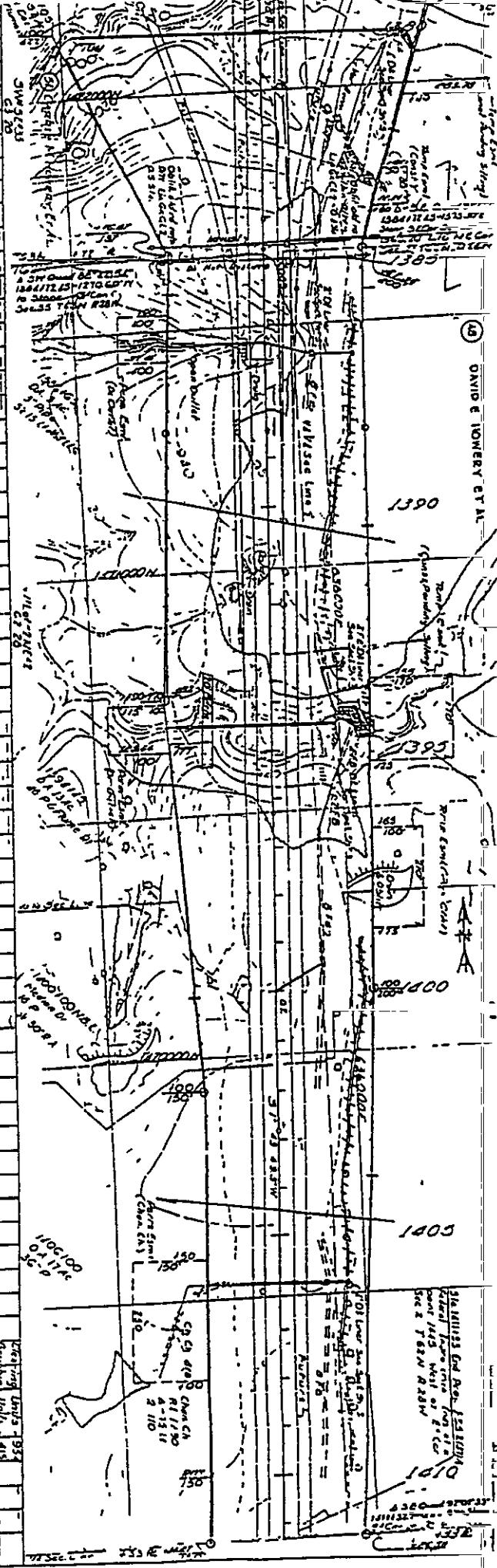


LTPP SPS Project Deviation Report Project Summary Sheet	State Code 29 Project Code 06**
Project Classification Information	
SPS Experiment Number: 6	State or Province: MISSOURI
LTPP Region:	<input type="checkbox"/> North Atlantic <input checked="" type="checkbox"/> North Central <input type="checkbox"/> Southern <input type="checkbox"/> Western
Climate Zone:	<input type="checkbox"/> Dry-Freeze <input type="checkbox"/> Dry-No Freeze <input checked="" type="checkbox"/> Wet-Freeze <input type="checkbox"/> Wet-No Freeze
Subgrade Classification:	<input checked="" type="checkbox"/> Fine Grain <input type="checkbox"/> Coarse Grain <input type="checkbox"/> Active (SPS-8 Only)
Project Experiment Classification Designation (SPS 1, 2 and 8):	
Construction Start Date: May, 1992	Construction End Date: October, 1992
FHWA Incentive Funds Provided to Agency for this Project:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Deviation Summary	
Site Location Deviations:	<input type="checkbox"/> No Deviations <input checked="" type="checkbox"/> Minor Deviations <input type="checkbox"/> Significant Deviations
Construction Deviations:	<input type="checkbox"/> No Deviations <input checked="" type="checkbox"/> Minor Deviations <input type="checkbox"/> Significant Deviations
Data Collection and Processing Status Summary	
Inventory Data (SPS 5,6,7,9):	<input checked="" type="checkbox"/> Complete Submission <input type="checkbox"/> Incomplete <input type="checkbox"/> Data Not Available
Materials Data:	<input type="checkbox"/> All Scheduled Samples Obtained and Tested <input type="checkbox"/> Incomplete/No Test Data
Construction Data:	<input type="checkbox"/> All Required Data Obtained <input type="checkbox"/> Incomplete/Missing Data Elements
Historical Traffic Data:	<input checked="" type="checkbox"/> All Required Historical Estimates Submitted (SPS 5,6,7,9) <input type="checkbox"/> Required Estimates Not Submitted
Traffic Monitoring Equipment:	<input type="checkbox"/> WIM Installed On-Site <input type="checkbox"/> AVC Installed On-Site <input type="checkbox"/> ATR Installed On-Site <input checked="" type="checkbox"/> No Equipment Installed
Traffic Monitoring:	<input type="checkbox"/> Preferred <input type="checkbox"/> Continuous <input checked="" type="checkbox"/> Minimum <input type="checkbox"/> Below Minimum <input type="checkbox"/> Site Related
Traffic Monitoring Data:	<input checked="" type="checkbox"/> Monitoring Data Submitted <input type="checkbox"/> No Monitoring Data Submitted
FWD Measurements:	<input checked="" type="checkbox"/> Preconstruction Tests Performed <input checked="" type="checkbox"/> Construction Tests Performed <input checked="" type="checkbox"/> Post-construction Tests Performed
Profile Measurements:	<input checked="" type="checkbox"/> Preconstruction Tests Performed <input checked="" type="checkbox"/> Post-construction Tests Performed
Distress Measurements:	<input checked="" type="checkbox"/> Preconstruction Tests Performed <input checked="" type="checkbox"/> Post-construction Tests Performed
Maint. & Rehab. Data:	<input checked="" type="checkbox"/> Complete Submission <input type="checkbox"/> Incomplete <input type="checkbox"/> Data Not Available
Friction Data:	<input checked="" type="checkbox"/> Complete Submission <input type="checkbox"/> Incomplete <input type="checkbox"/> Data Not Available
Report Status	
Materials Sampling and Test Plan:	<input checked="" type="checkbox"/> Document Prepared <input checked="" type="checkbox"/> Final Submitted to FHWA
Construction Report:	<input checked="" type="checkbox"/> Document Prepared <input type="checkbox"/> Final Submitted to FHWA
AWS: (SPS 1, 2, & 8)	<input type="checkbox"/> AWS Installed <input type="checkbox"/> AWS Installation Report Submitted to FHWA

Page 1 of 1 Preparer E.P. Hoff Date _____

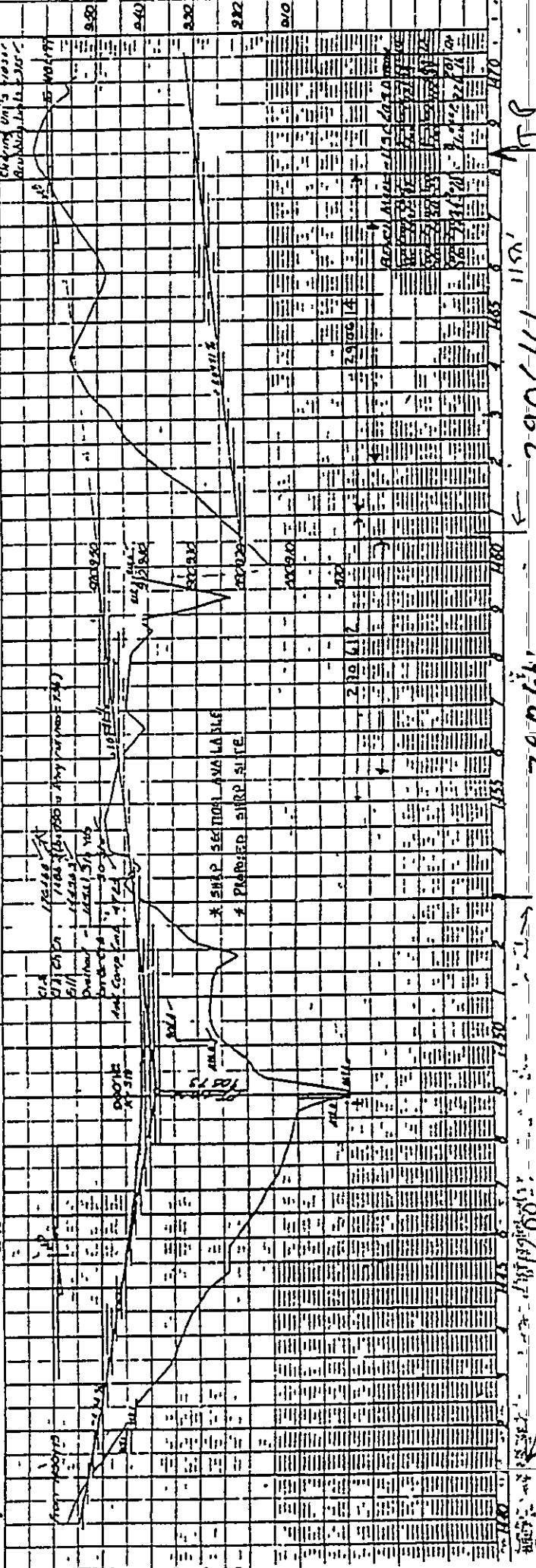
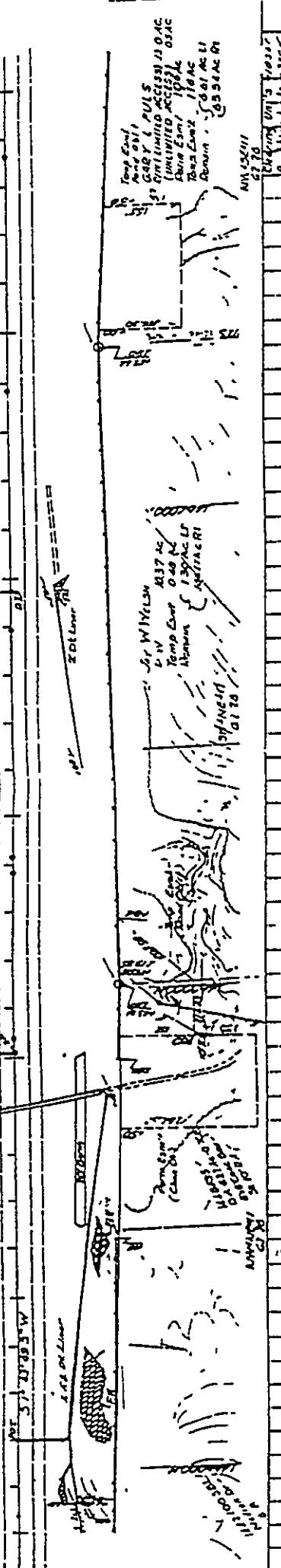
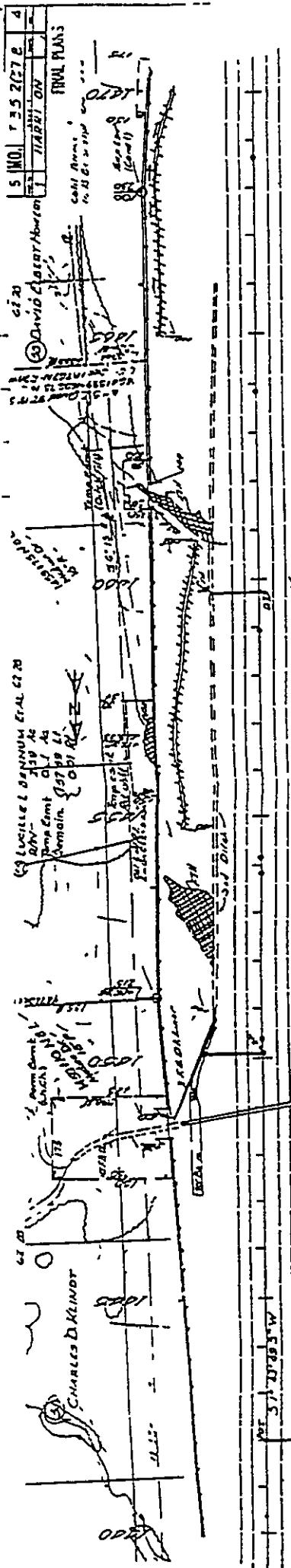
APPENDIX B
CONSTRUCTION PLAN AND PROFILE





290607

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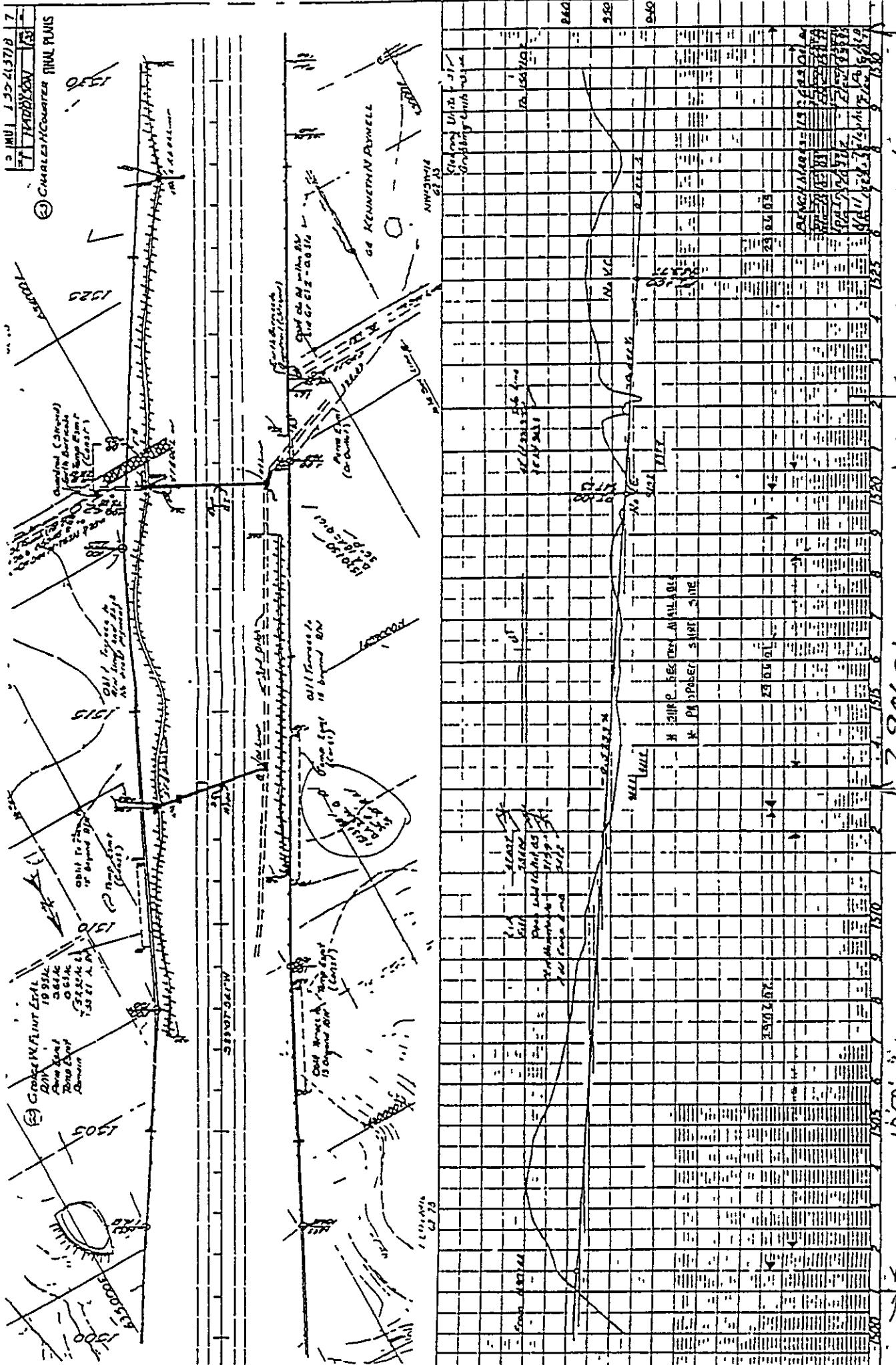


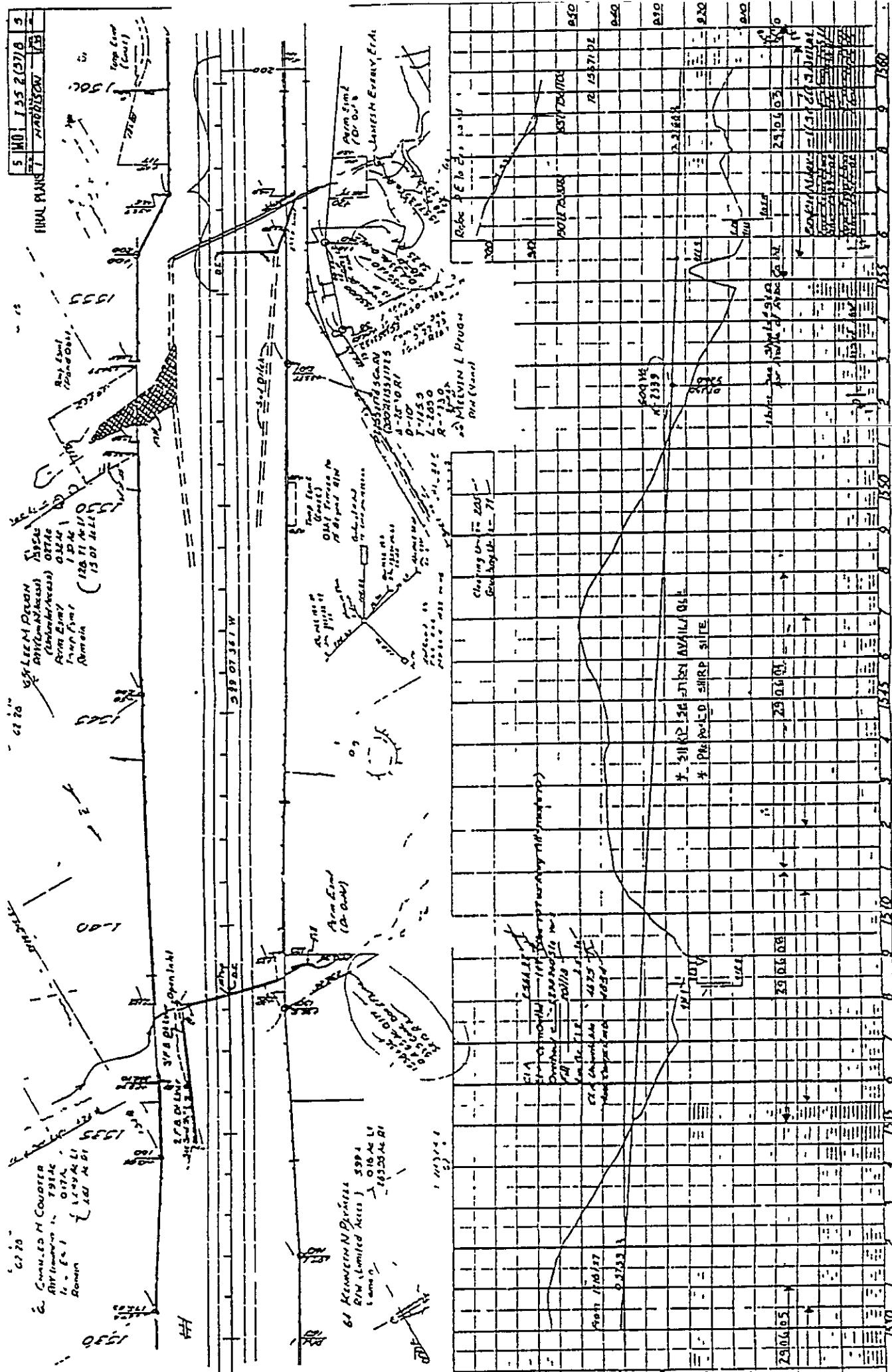
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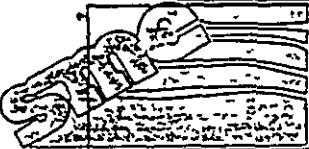




APPENDIX C

**PRE AND POST CONSTRUCTION MATERIAL SAMPLING
&
TESTING PLANS**





soil and materials engineers, inc.

43980 Plymouth Oaks Blvd Plymouth, MI 48170 (313) 454-9900 FAX (313) 454-0629

SPS6-MO

Kenneth W Kramer PE
Richard O Anderson PE
Garrett H Evans PE
Frank A Henderson PG
Edward S Lindow PE
Robert C Rabeler PE

Jerry B Givens PE
Larry P Jedebe PE
Starr D Kohn PhD PE
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Frank D Grelsheim PE
Bruce D Hulman PE PG
Christine R Johnson
Cheryl Kehres Deitrich
Paul C Larsen PE
Timothy J Mitchell, PE
T Thomas Okasinski PE
John C Zarzecki CWI

September 27, 1991

R. Bruce Loesch, P.E.
Senior Research Engineer
Materials & Research Division
Missouri Hwy & Transp Dept.
P.O.Box 270
Jefferson City, Missouri 65102

RE. Pre-Construction Sampling
SPS-6 Site
Harrison County, MO
SME Project P11500

Dear Mr. Loesch:

Attached, please find the revised sampling plan for the SPS-6 project. The preliminary plan which was transmitted last week was revised to account for changes in test pit locations. The total number of test pits remained the same. However, the number of augers, shoulder probes, and cores were increased slightly. If necessary, the number of shoulder probes can be reduced to maintain your schedule.

The attached plan is only a portion of the total sampling and testing plan for the SPS-6 site. However, we understand that you are scheduled to perform the field sampling next week. Therefore, we are providing you with the pre-construction sampling portion of the plan. This plan has not been reviewed by SHRP as required in the sampling guidelines. We will proceed with the remaining portions of the plan when SHRP officially approves the proposed site.

If you have any questions regarding this information, please do not hesitate to contact us.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.



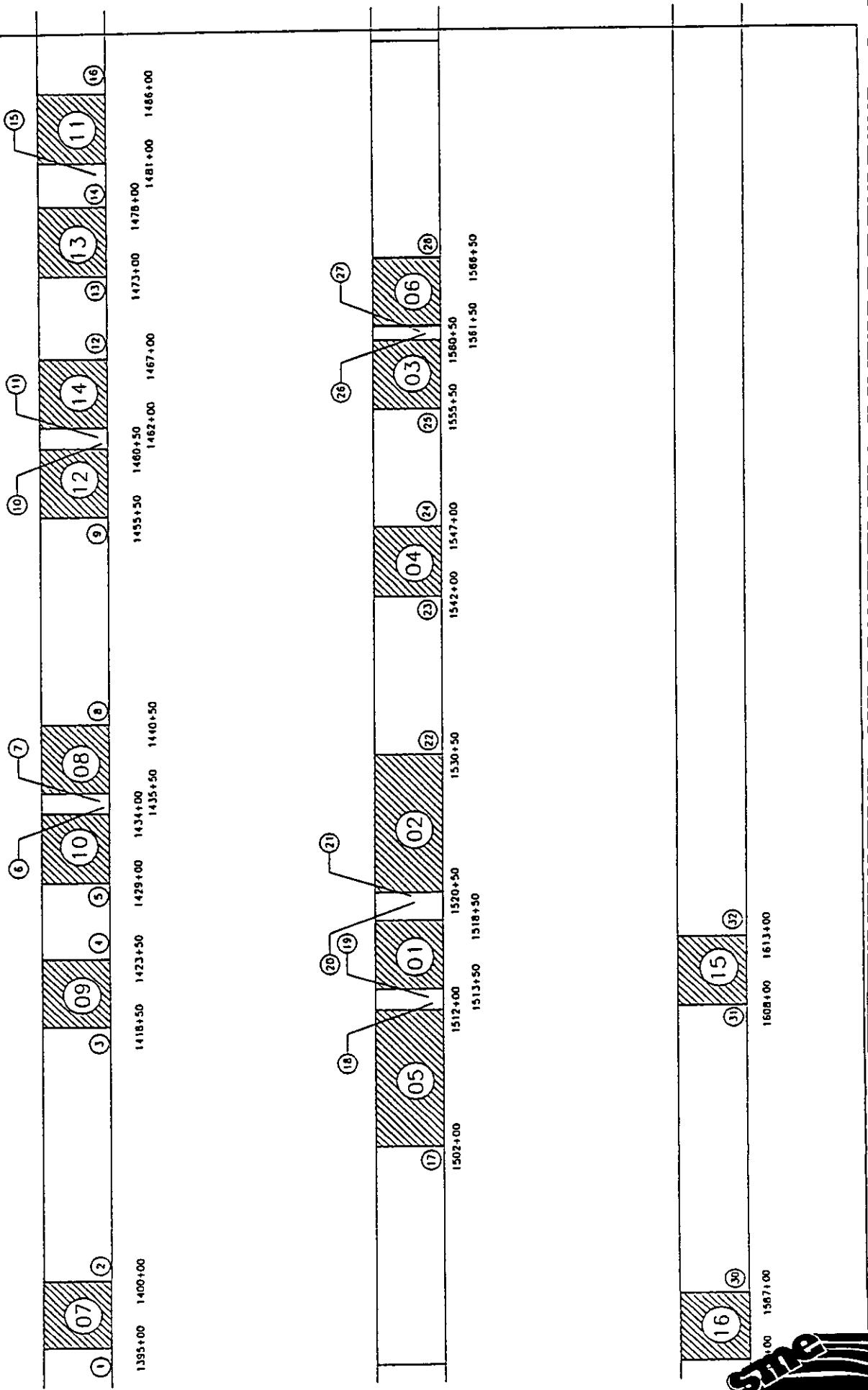
Chuck A. Gemayel, P.E.
Project Engineer



Starr D. Kohn, Ph.D., P.E.
Senior Associate

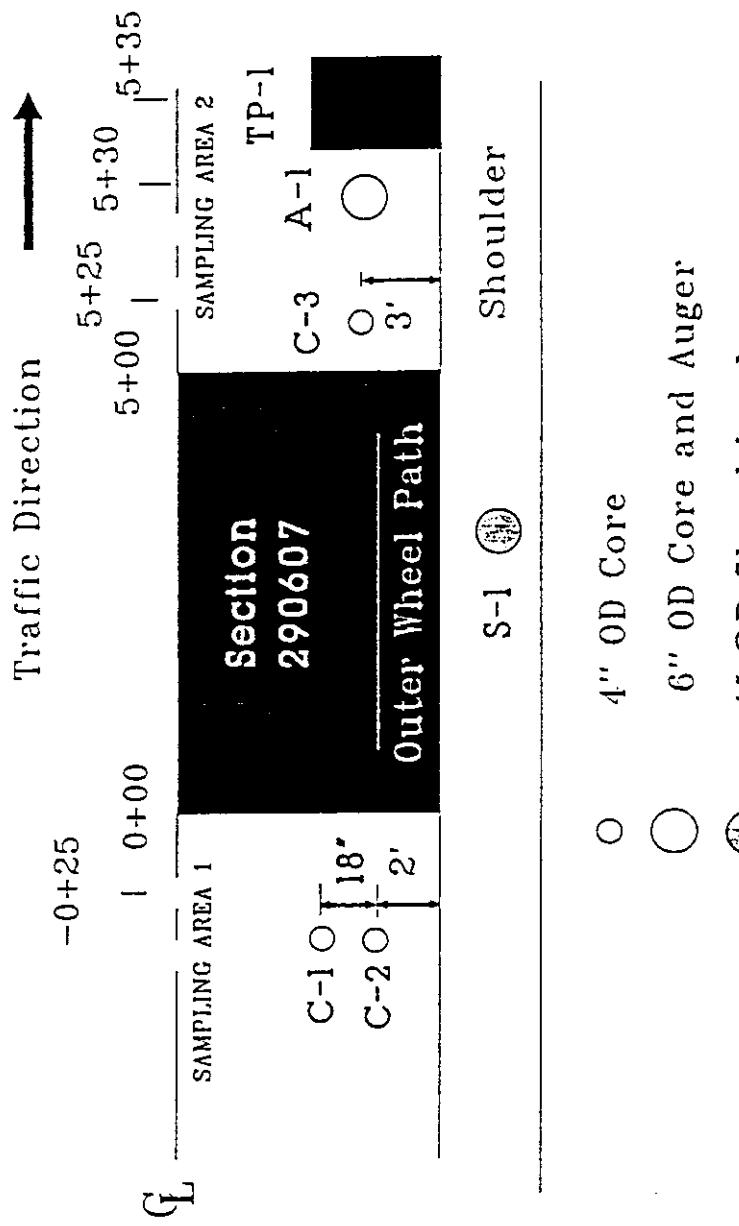
CC Richard C Ingberg, SHRP NCRE
Dr Eugene L Skok, SHRP NCROC

PRE-CONSTRUCTION SAMPLING PLAN
 MISSOURI SPS-6 SITE
 I-35, HARRISON COUNTY
 SHRPID = 2906***



"Pre-Construction" Sampling Plan

Missouri SPS-6



0



4'x6' Test Pit

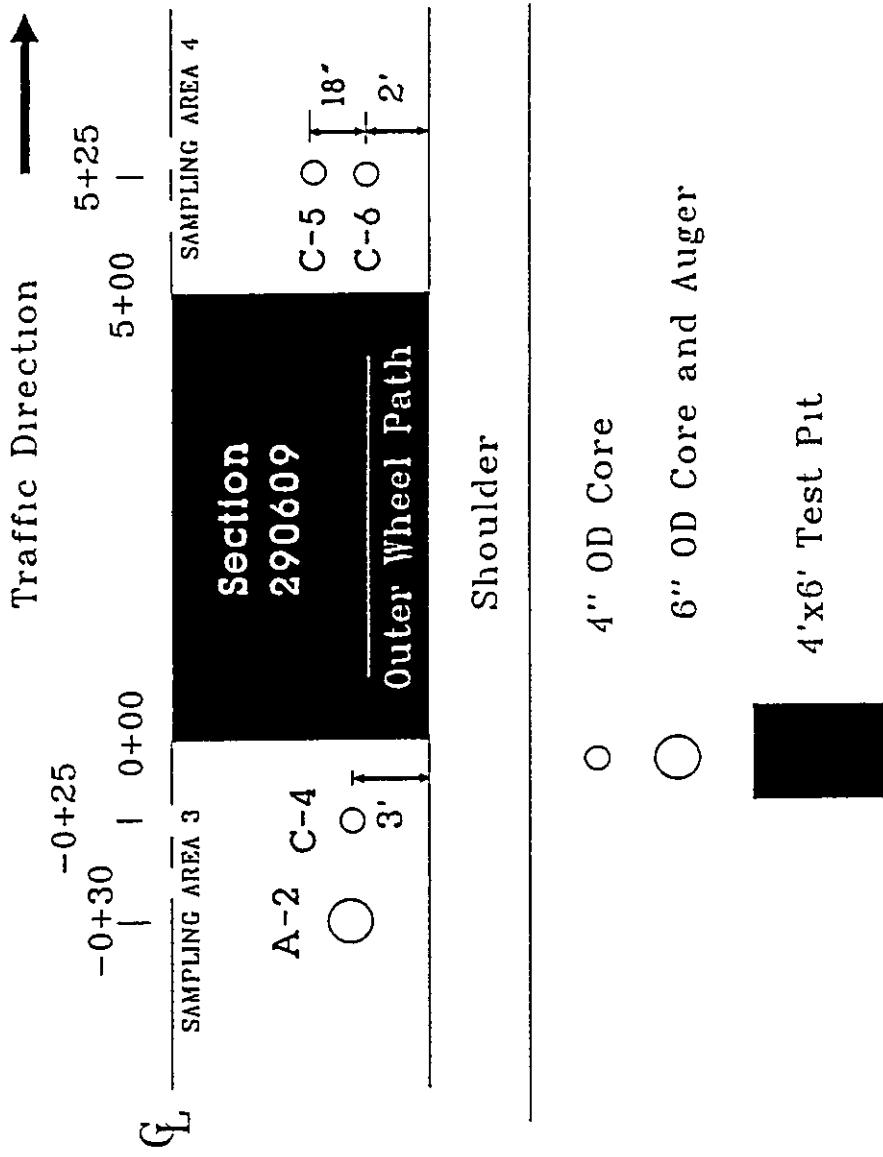
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PAGE 1 OF 16

"Pre-Construction" Sampling Plan

Missouri SPS-6



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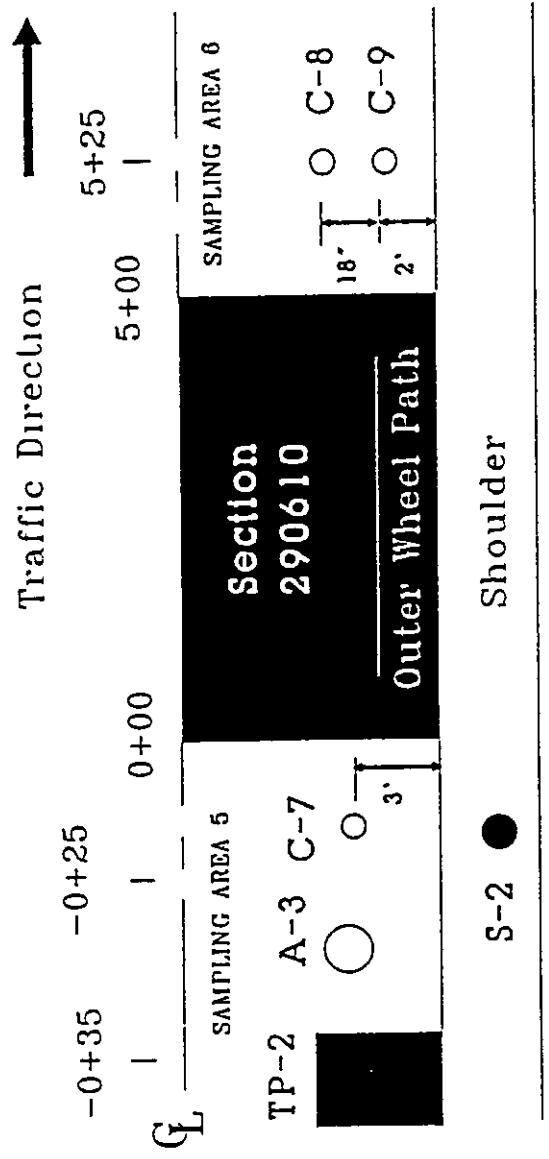
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PAGE 2 OF 16

"Pre-Construction" Sampling Plan

Missouri SPS-6



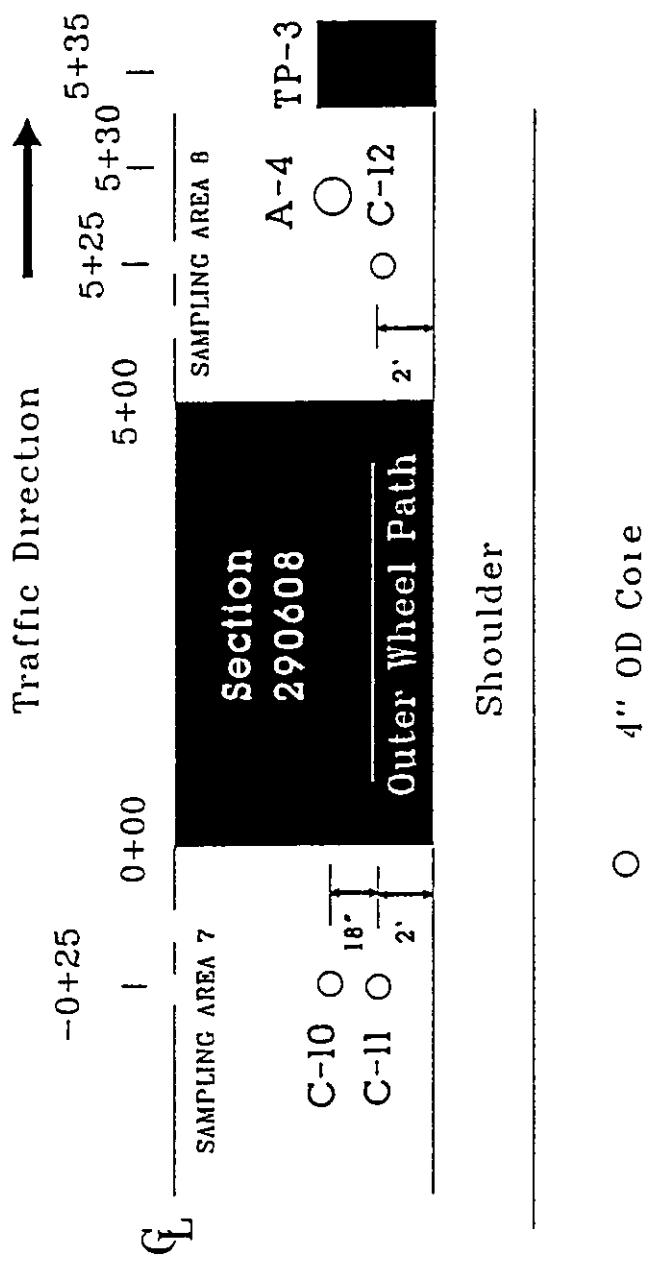
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"Pre-Construction" Sampling Plan

Missouri SPS-6



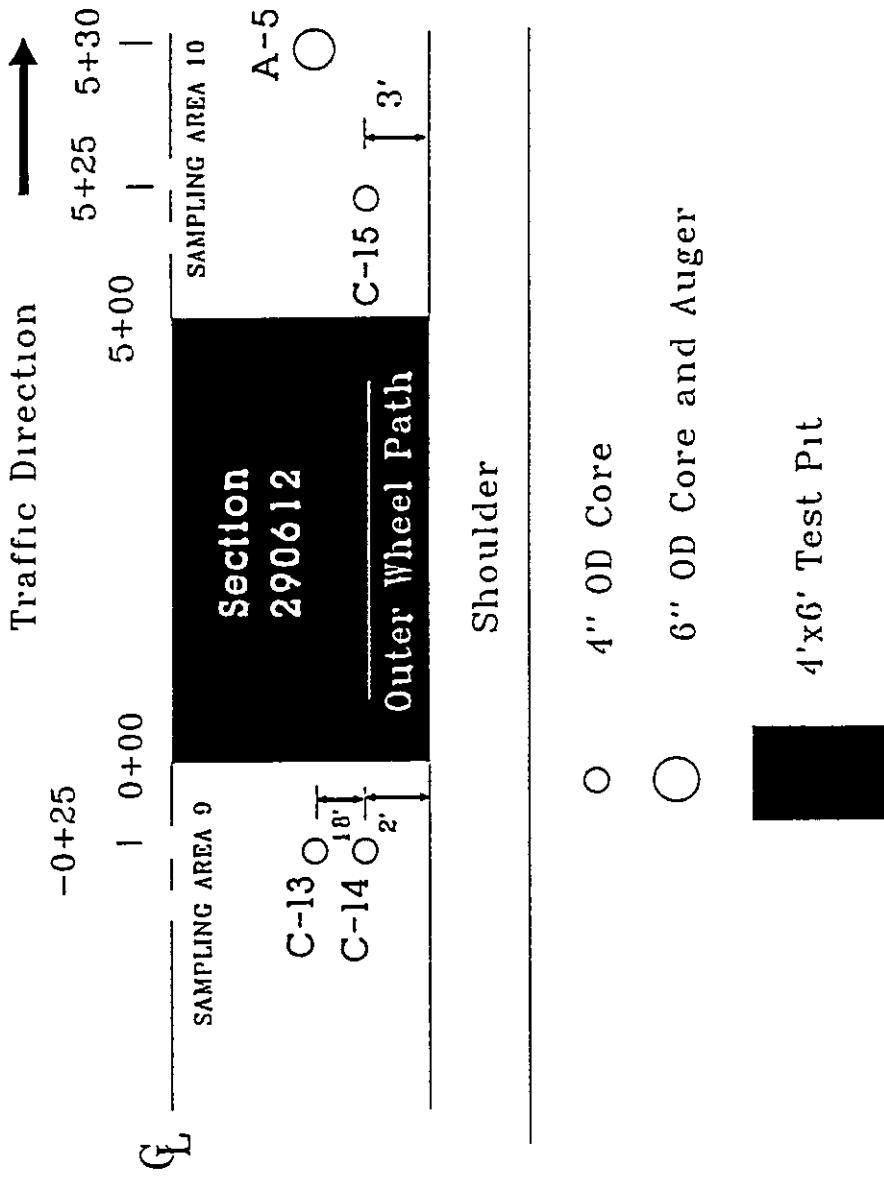
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I-35, Harrison County



"Pre-Construction" Sampling Plan

Missouri SPS-6



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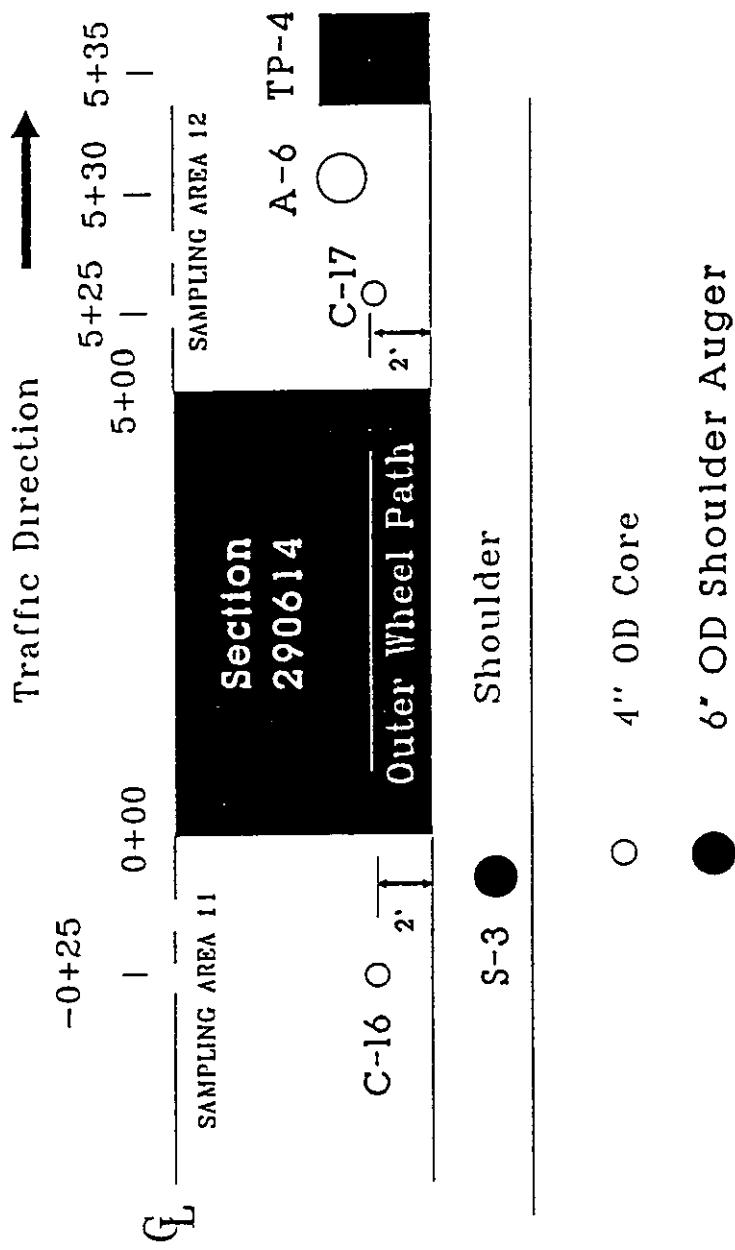
I-35, Harrison County



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PAGE 5 OF 16

"Pre-Construction" Sampling Plan

Missouri SPS-6



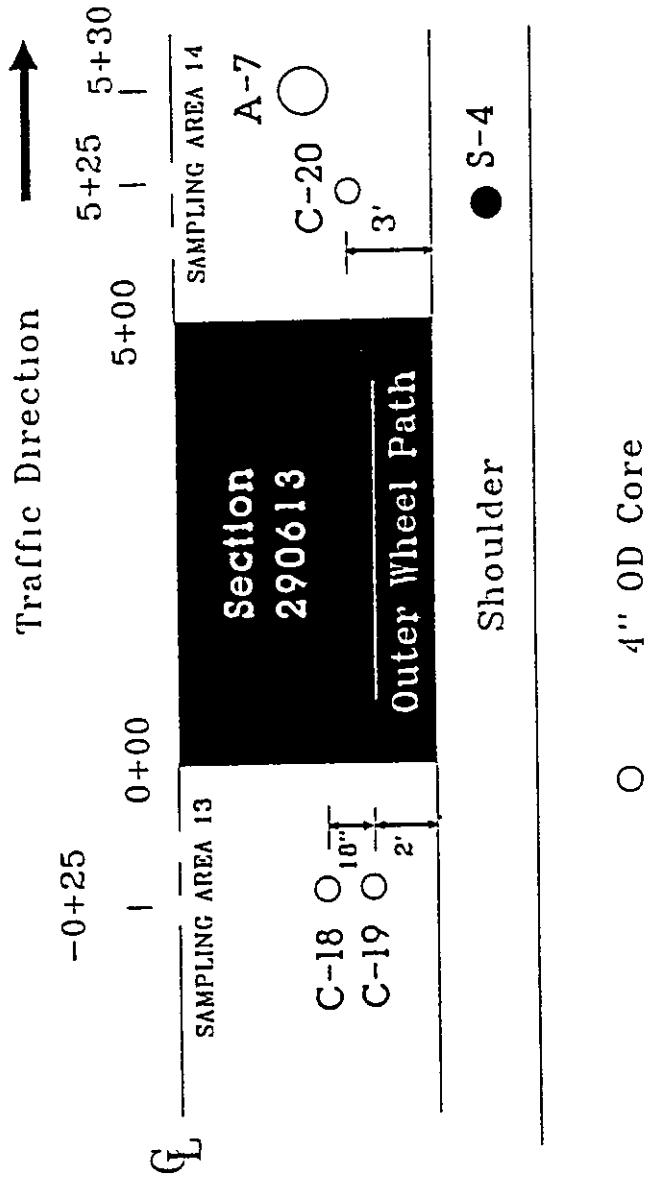
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I-35, Harrison County

SNC

"Pre-Construction" Sampling Plan

Missouri SPS-6



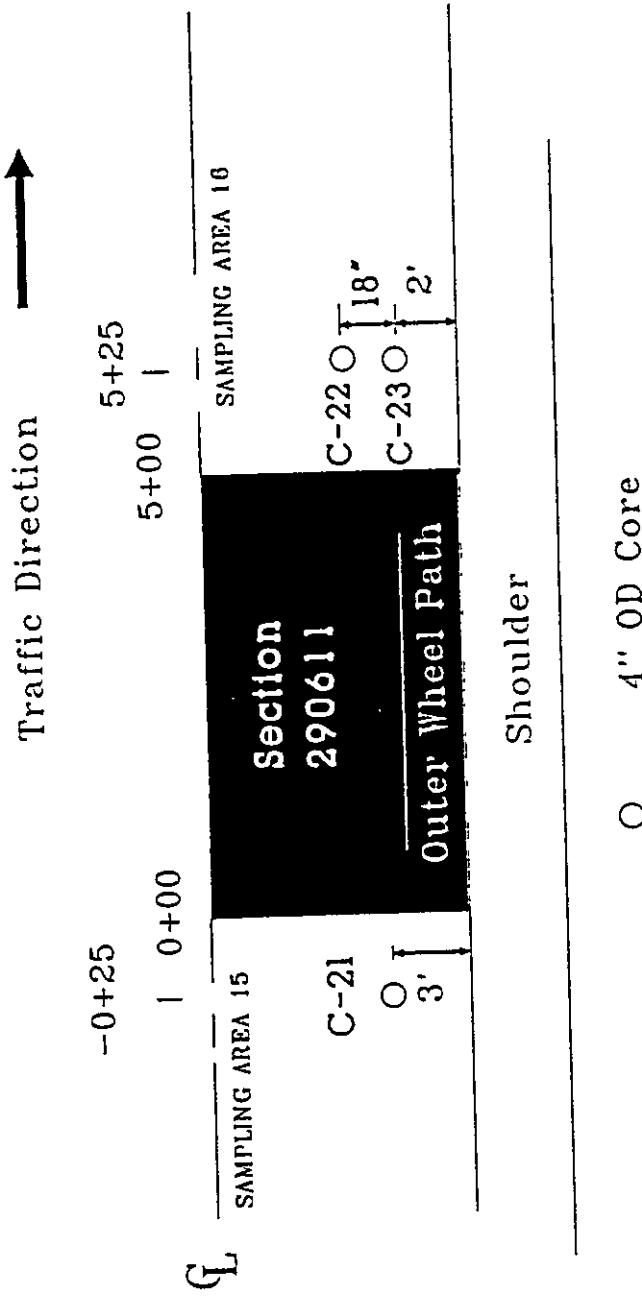
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I-35, Harrison County

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"Pre-Construction" Sampling Plan

Missouri SPS-6



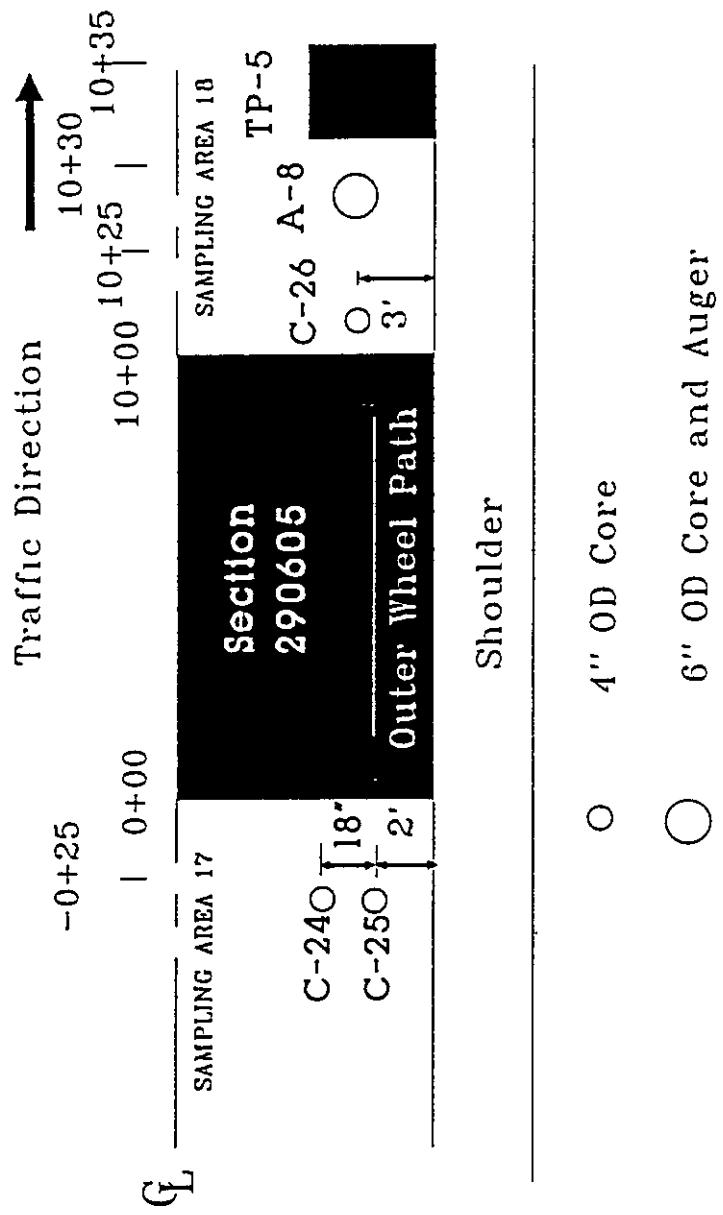
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I-35, Harrison County

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"Pre-Construction" Sampling Plan

Missouri SPS-6



- 4" OD Core
 - 6" OD Core and Auger
- 4'x6' Test Pit

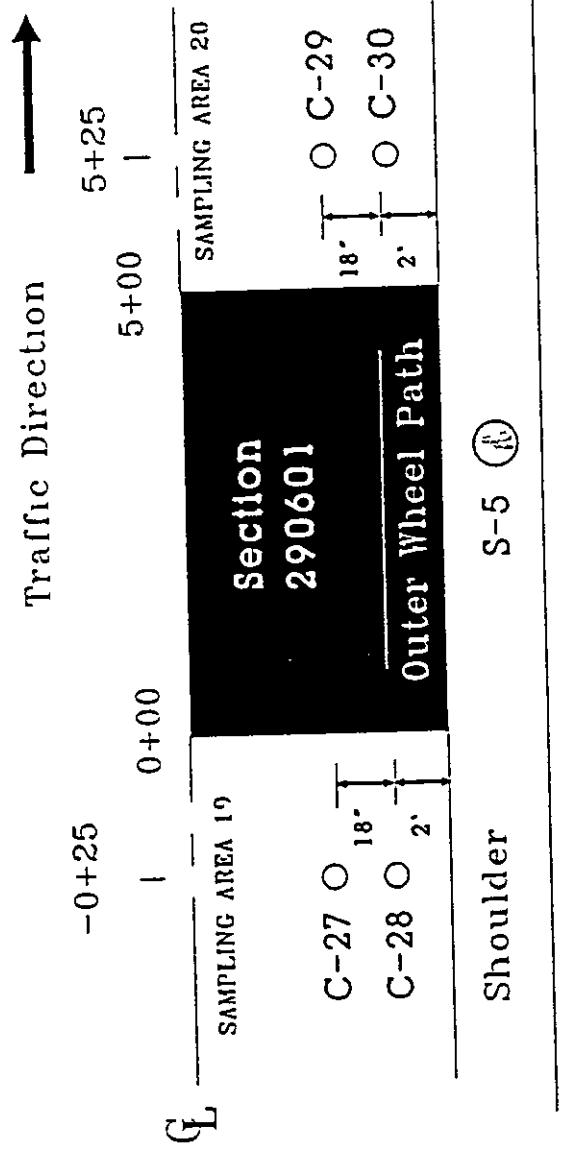
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I-35, Harrison County

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"Pre-Construction" Sampling Plan

Missouri SPS-6

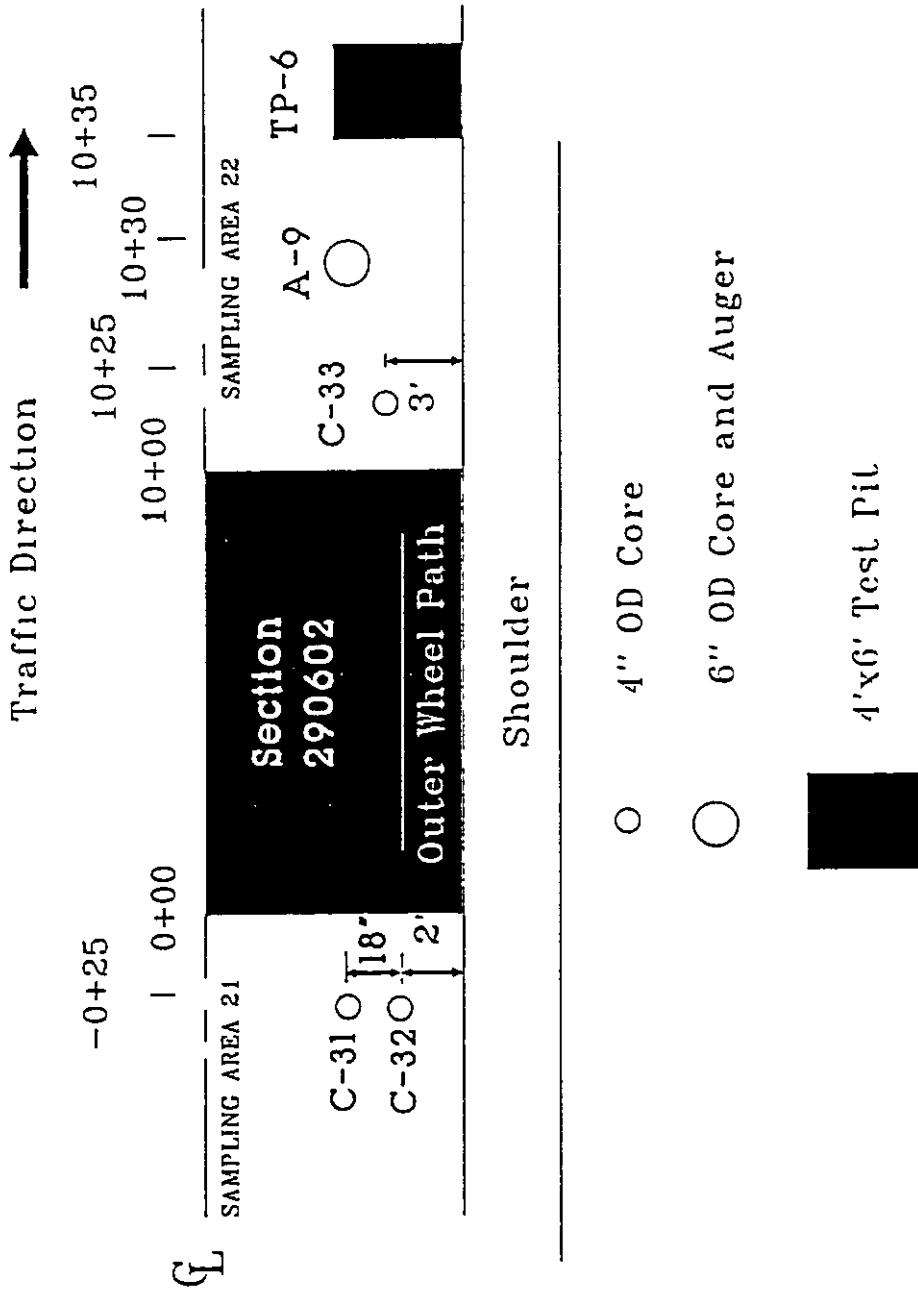


- 4" OD Core
- 6" OD Shoulder Auger

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"Pre-Construction" Sampling Plan

Missouri SPS-6



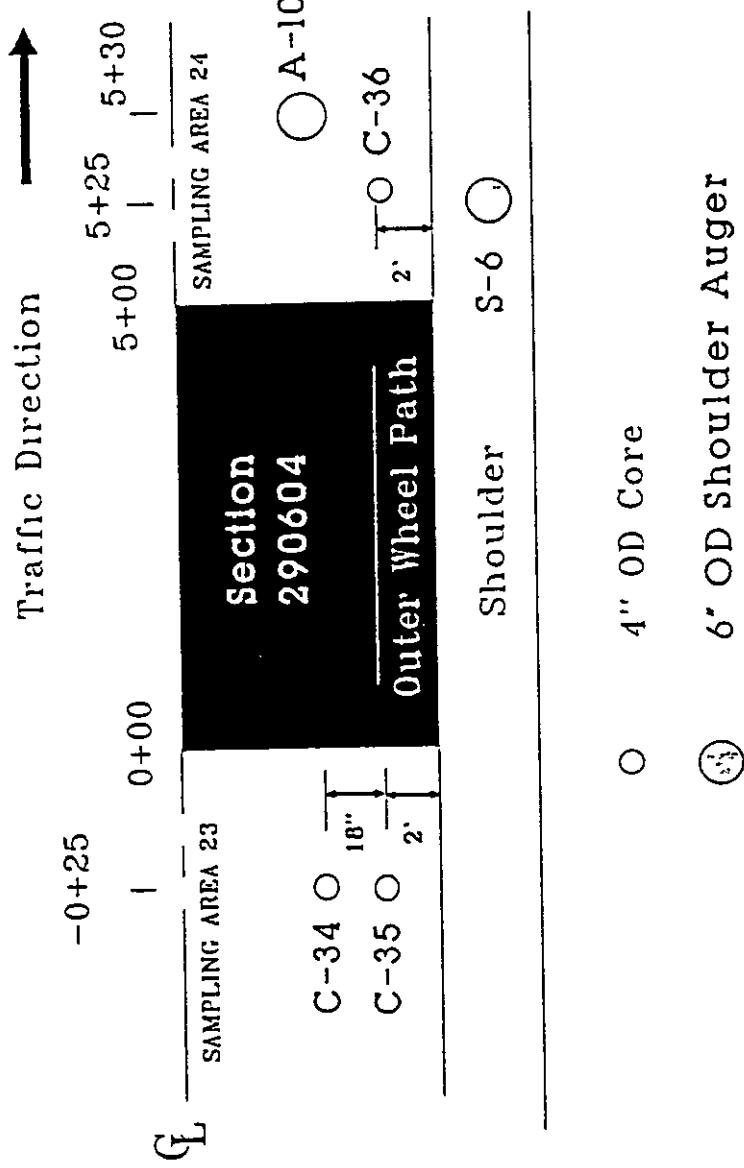
I-35, Harrison County



PREPARED ON 9/26/91
PAGE 11 OF 16

"Pre-Construction" Sampling Plan

Missouri SPS-6



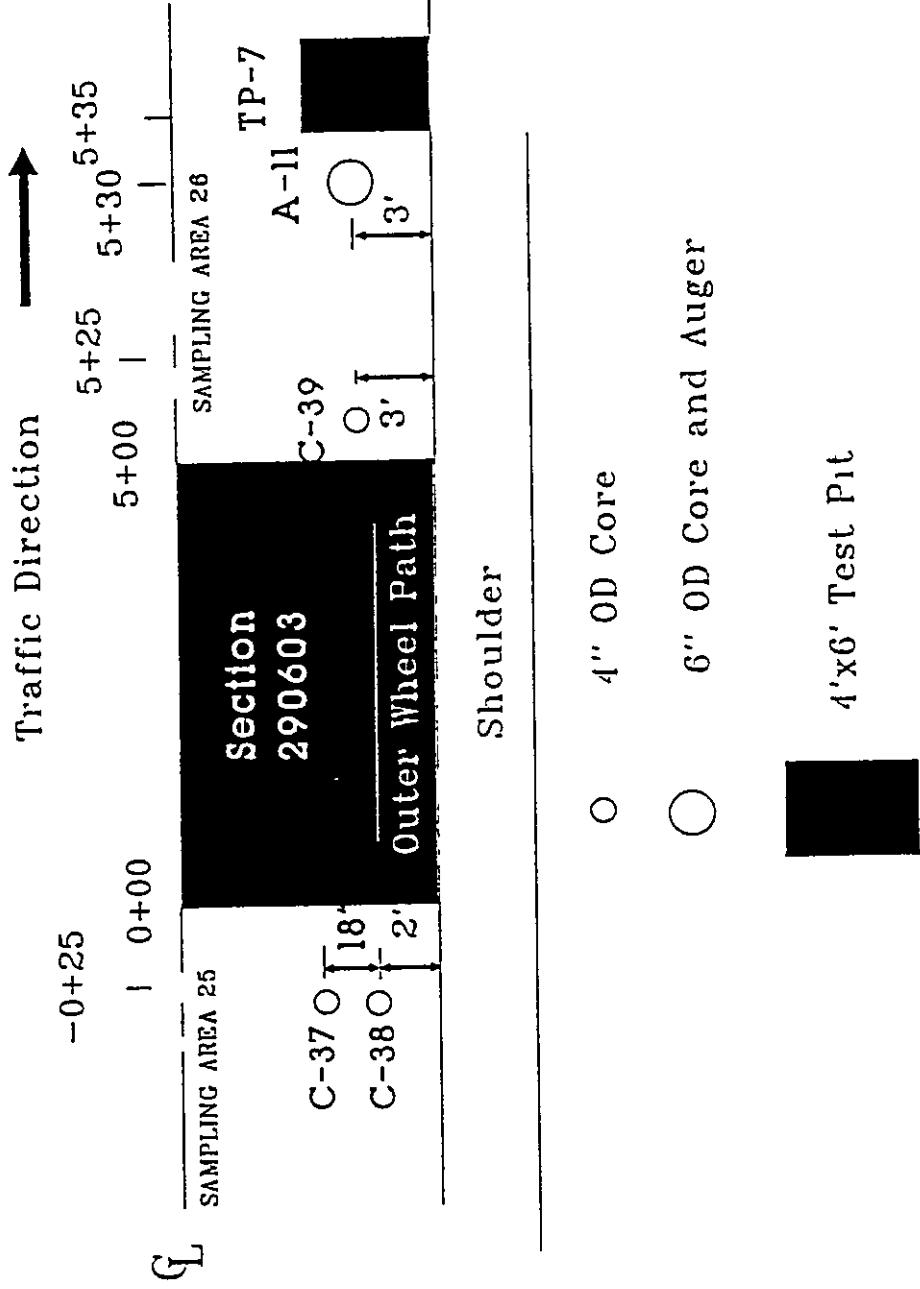
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I-35, Harrison County

Sure

"Pre-Construction" Sampling Plan

Missouri SPS-6

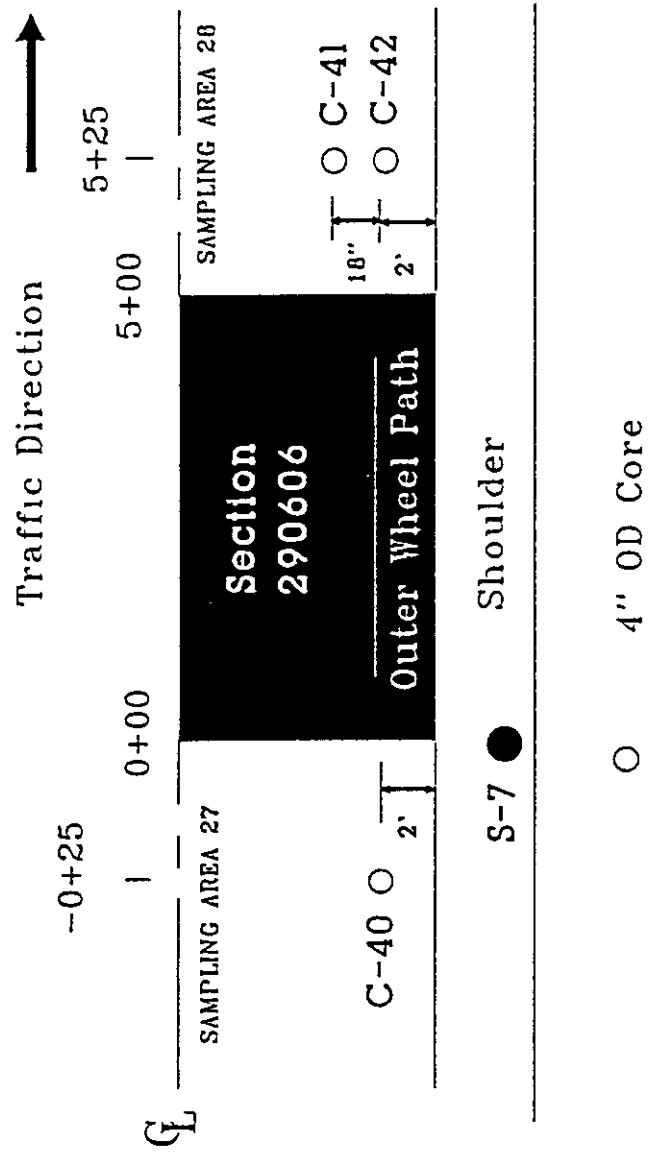


I-35, Harrison County

SITE

"Pre-Construction" Sampling Plan

Missouri SPS-6



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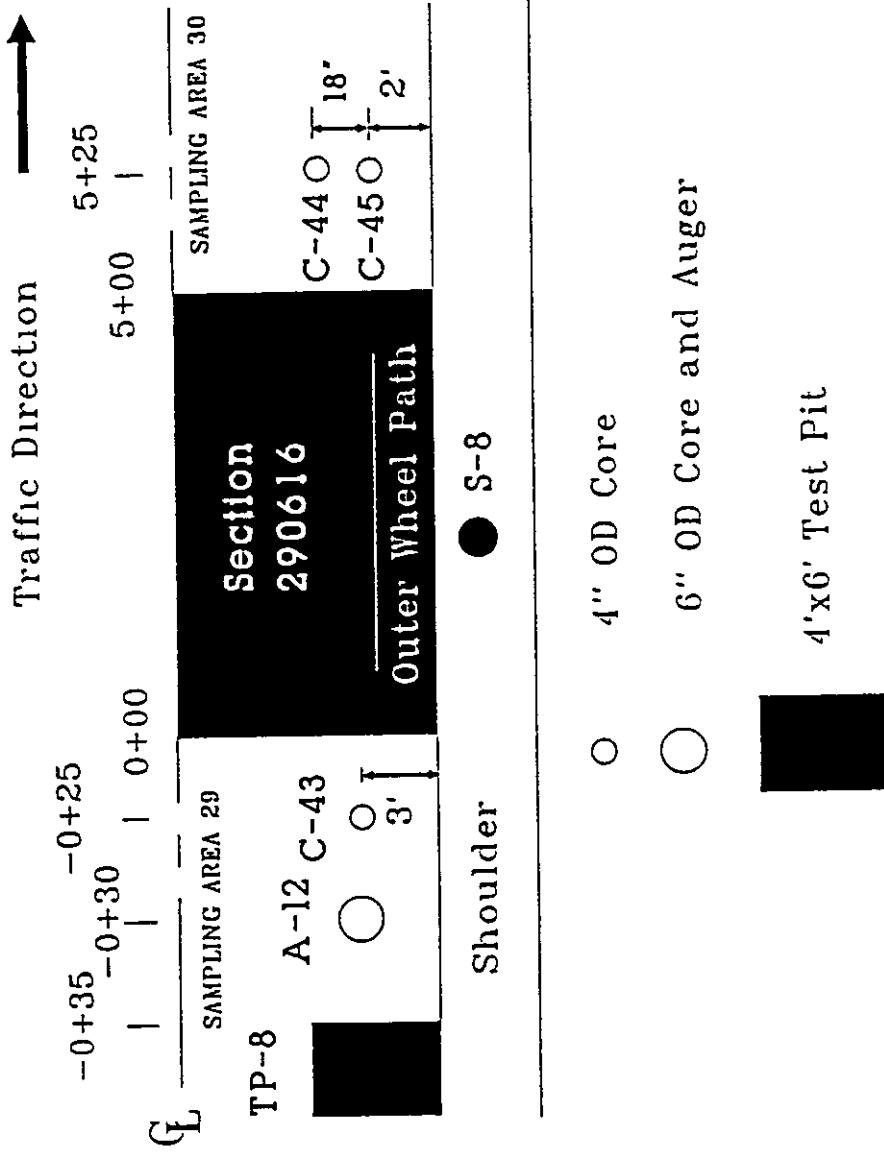
I-35, Harrison County



PREPARED ON 9/26/91
PAGE 14 OF 16

"Pre-Construction" Sampling Plan

Missouri SPS-6



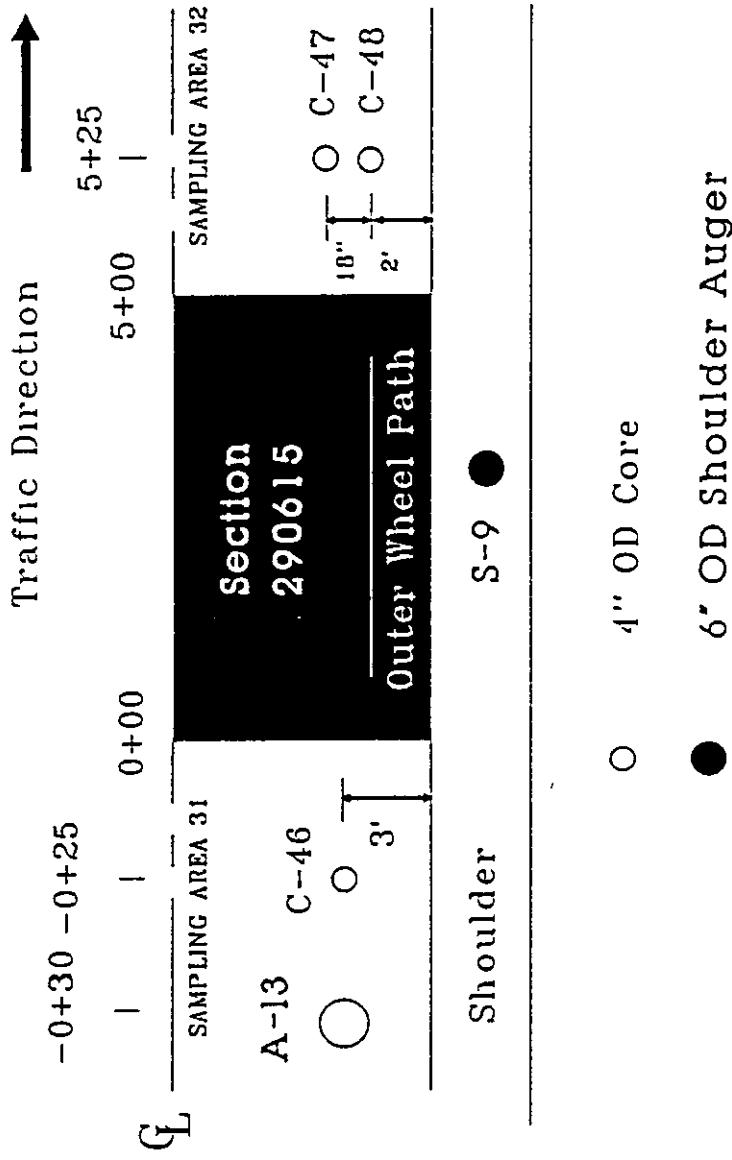
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I-35, Harrison County

SPS

"Pre-Construction" Sampling Plan

Missouri SPS-6



0

I-35, Harrison County



PRE-CONSTRUCTION LABORATORY TESTING PLANS

MATERIAL TYPE AND PROPERTIES	SHAP DESIGNATION	SHAP PROTOCOL	TESTS PER LAYER	MATERIAL SOURCE TEST LOCATIONS
I PORTLAND CEMENT CONCRETE				
Compressive Strength	PC01	P61	24	C2 C5 C6 C9 C10 C12 C13 C15 C18 C20 C23 C25 C27 C28 C31 C33 C34 C37 C40 C42 C43 C46 C48
Splitting Tensile Strength	PC02	P62	24	C1 C3 C4 C7 C8 C11 C14 C16 C17 C19 C21 C22 C24 C26 C29 C30 C32 C35 C36 C38 C39 C41 C44 C45 C47
PCC Coefficient of Thermal Expansion	PC03	P63	12	A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13
Static Modulus of Elasticity	PC04	P64		
PCC Unit Weight	PC05	P65	24	C2 C5 C6 C9 C10 C12 C13 C15 C18 C20 C23 C25 C27 C28 C31 C33 C34 C37 C40 C42 C43 C46 C48
Core Examination/Thickness	PC06	P66	36	ALL CORES
II BOUND (TREATED) BASE AND SUBBASE				
Type and Classification of Material	TB01	P31		N/A
Pozzolanic Cementitious Compressive Strength	TB02	P32		N/A
Asphalt Treated Dynamic Modulus (77F)	TB03	P33		N/A
HMAC Resilient Modulus	AC07	P07		N/A
III UNBOUND GRANULAR BASE AND SUBBASE				
Particle Size Analysis	UG01	P41	8	TP1-TP8
Sieve Analysis (washed)	UG02	P41	8	TP1-TP8
Atterberg Limits	UG04	P43	8	TP1-TP8
Moisture-Density Relations	UG05	P44	8	TP1-TP8
Resilient Modulus	UG07	P46	8	TP1-TP8
Classification	UF08	P47	8	TP1-TP8
Permeability	UF09	P48	8	TP1-TP8
Natural Moisture Content	UF10	P49	8	TP1-TP8



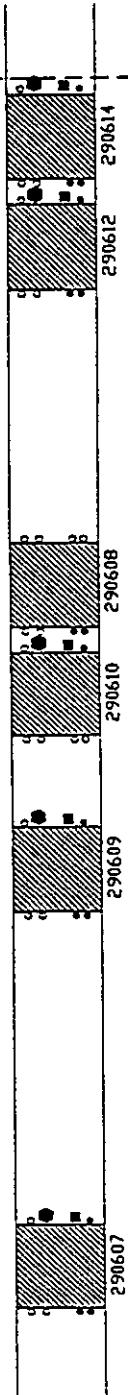
PRE-CONSTRUCTION LABORATORY TESTING PLANS CON'T

MATERIAL TYPE AND PROPERTIES	SHRP DESIGNATION	SHRP PROTOCOL	TESTS PER LAYER	MATERIAL SOURCE TEST LOCATIONS
IV SUBGRADE				
Sieve Analysis	SS01	P51	8	TP1-TP8
Hydrometer or 0.001 mm	SS02	P42	8	TP1-TP8
Atterberg Limits	SS03	P43	8	TP1-TP8
Classification	SS04	P52	20	TP1-TP8 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A
Moisture Density Relations	SS05	P55	8	TP1-TP8
Resilient Modulus	SS07	P46	12	A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13
Unit Weight	SS08	P56	20	TP1-TP8 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A
Natural Moisture Content	SS09	P49	8	TP1-TP8
Depth of Rigid Layer			9	S1 S2 S3 S4 S5 S6 S7 S8 S9

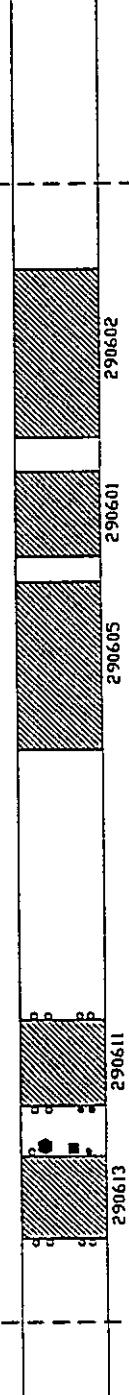


**POST CONSTRUCTION TESTING
CORE ASSIGNMENT
MISSOURI SPS-6 PROJECT
I-35 SB**

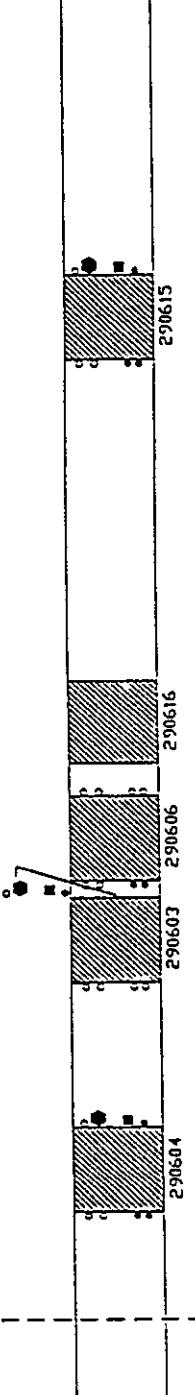
MATCH LINE



MATCH LINE



MATCH LINE



- CORES NOT TESTED
- CORES TESTED FOR CREEP COMPLIANCE
- CORES TESTED FOR RESILIENT MODULUS
- ◆ CORES TESTED FOR INDIRECT TENSION

SMP

TABLE 1
MISSOURI SPS-6 POST-CONSTRUCTION MATERIALS SAMPLING AND TESTING
LABORATORY TESTING OF CORES

MATERIAL TYPE AND PROPERTIES	SHRP DESIGNATION	SHRP PROTOCOL	TESTS PER LAYER	MATERIAL SOURCE/ TEST LOCATIONS
A ASPHALT CONCRETE				
CORE EXAMINATION/THICKNESS	AC01	P01	48	ALL CORES TAKEN AT 2' AND 3.5' OFFSETS, BEFORE AND AFTER EACH TEST SECTION
BULK SPECIFIC GRAVITY	AC02	P02	48	ALL CORES TAKEN AT 2' AND 3.5' OFFSETS, BEFORE AND AFTER EACH TEST SECTION
CREEP COMPLIANCE (NOTE 1)	AC06	P06	9	C64, C80, C104, C152, C176, C192, C224, C240, C272
RESILIENT MODULUS (NOTE 1)	AC07	P07	27	[C61, C62, C66], [C77, C78, C82], C106, C125, C126, [C149, C150, C164], [C173, C174, C178]
TENSILE STRENGTH (NOTE 1)	AC07	P07	9	C194, C205, C206, [C221, C222, C226], C232, C253, C254, [C269, C270, C274]
				C65, C81, C105, C153, C177, C193, C225, C241, C273

SAMPLES IN BRACKETS INDICATE SAMPLES TAKEN FROM THE SAME TEST SECTION

NOTE 1 TESTING TO BE PERFORMED THROUGH FHWA. STORE SAMPLES UNTIL FURTHER NOTICE

SMPC

TABLE 1
MISSOURI SPS-6 POST-CONSTRUCTION MST
CORE LOCATIONS AND DESIGNATIONS

TEST SECTION	BEFORE (0+25)	AFTER (5+25)
290607	C267-270	C271-274
290609	C75-78	C79-82
290610	C99-102	C103-106
290608	C123-126	C127-130
290612	C147-150	C151-154
290614	C171-174	C175-178
290613	C187-190	C191-194
290611	C203-206	C207-210
290605	NO AC OVERLAY	NO AC OVERLAY
290601	NO AC OVERLAY	NO AC OVERLAY
290602	NO AC OVERLAY	NO AC OVERLAY
290604	C219-222	C223-226
290603	C235-238	C239-242
290606	C251-254	C255-258
290615	C267-270	C271-274
290616	NO AC OVERLAY	NO AC OVERLAY

APPENDIX D

**LETTERS REPORTING SECTIONS 290607
&
290609 POST CONSTRUCTION PROBLEMS**





STRATEGIC HIGHWAY RESEARCH PROGRAM

North Central Region 1983 Sloan Place Suite 10 St Paul, MN 55117 Tel (612) 776-2210 Fax (612) 776-7201

RICHARD C INGBERG
Regional Engineer

June 21, 1993

Mr. William L. Trimm
Division Engineer, Materials and Research
Missouri Highway and Transportation Department
P.O. Box 270
Jefferson City, MO 65102

Subject: SPS-6, located on I-35 south of Bethany, Missouri
Maintenance of Pavement

Dear Bill:

Bob Girard, the LTPP contact from the Missouri Highway and Transportation Department called me regarding a meeting with maintenance personnel from the St. Joseph District on this project. The meeting was held on June 3, 1993 at Bethany, MO. Prior to the meeting I reviewed the site and took pictures of the sections containing various levels of distress.

After lunch Bruce Loesch and Vernon Adams from the Materials and Research Office in Jefferson City and I reviewed the condition of the pavement.

Later in the afternoon we met with the District Maintenance personnel and Tom Taylor from the District Materials office to go over the plans for patching the test sections. They plan to patch the sections with isolated failures by sawing and removing the asphalt pavement, and removing the loose concrete to at least the aggregate base and replace with hot mix asphalt. Harold Helton, Bethany, had made a similar patch in the fall of 1992 and it is performing well. In the control section 290601 (original P.C.C. pavement) they plan to remove up to 50 feet of pavement and replace with P.C.C. pavement. They will document and take pictures of all the work done within the test sections.

We appreciate the efforts these people have made to keep us informed and provide data to document what is happening to these sections under traffic.

It was also noted that the edge drains had a white residue leaching from the drain outlets. They took samples of the effluent and will analyze in their Jefferson City laboratory.

We will send a set of pictures taken at the site to Bill Trimm, the SHRP Coordinator, and include a set for Bob Girard, the LTPP Contact.

The following pages contain the field review, the description

of pictures, and a listing of attendees at the meetings.

Sincerely,

Dick

Richard Ingberg
Regional Engineer

cc: Bob Girard
Monte Symons
Shiraz Tayabji PCS/Law
E.L. Skok
SME

Notes from June 3 field review with Bruce Loesch & Vernon Anderson

290607: Crack and seat, 4" AC overlay, edge drains

No visible distress although possible light snowplow damage, one crack is obvious in middle of section. Note that the FWD did not show a problem in this section. One section was double broke. Claimed that the first breaking was inadequate and this is where deterioration is most noticeable (this is outside the test section). Staining in wheel path (water surfacing). Distress @ 262 or 263.

290609: Crack and seat, 4" AC overlay, no edge drains

0+30 has staining in CL. Section looked good overall. 1+75-2+25 -Pumping. @ 2+50 there is a patch, more staining (2+60-3+00). Patches @ 3+50, 4+25, 4+65. Pumping @ 4+75-5+25.

290610. Crack and seat, 8" AC overlay

Pumping before section begins, staining on shoulder before and after test section.

290608: Crack and seat, 8" AC overlay, edge drains

Pumping between the sections.

290612: Rubblized, 8" AC overlay, edge drains

Possibly slight rutting in wheel paths. No distress evident.

290614 Rubblized, 8" AC overlay

Leaching at the following stations: 0+00, 0+50, 0+60.

290613. NOTE: Rubblized, 4" AC overlay is on plans,

Rubblized, 12" AC overlay on observation tape

Unable to decipher tape. Minor leaching evident.

290611: NOTE: Rubblized, 4" AC overlay, edge drains, on plans

Rubblized, 12" AC overlay on observation tape

No evident distress.

290605. PCC Maximum restoration, edge drains

Part of section breaking up. Water distress in shoulder @ 7+00.

290601. PCC control section

X in section (slated for removal). Patch in section @ 4+50 higher than section. 5+00 spalling.

290604: Minimum restoration, 4" AC overlay, saw and seal

No comments.

290603: Minimum restoration, 4" AC overlay

No comments.

290606. Maximum restoration, 4" AC overlay, edge drains

Fill section - possible cause of leaching

290616 PCC, minimum restoration, undersealing

D cracking in CL at 3+05 and some joints

290615. Typical project construction, 5" AC overlay

No comments

Description of Pictures: SPS-6 south of Bethany, MO

CL (centerline), WP (wheel path)

- 290607: Crack and seat, 4" AC overlay, edge drains
1: NE looking at 607 from 4+75
2: E looking at 607 from 5+00
3: CL 607 looking south at distress @ 5+00
4: CL distress @ 5+75
5: CL distress @ 5+80
6: Edge distress @ 6+00
7: WP distress @ County Mile Post 26.1
8: Breakage near edge @ 5+00 between 607 and 609 (double breakage area)
9: same as # 8
10: CL, 0.1 miles from 5+00
- 290609: Crack and seat, 4" AC overlay
11: Downgrade section
12: Looking south from 0+00 edges here
13: WP @ 4+75
14: 6+00
- 290610: Crack and seat, 8" AC overlay
15: Looking south, downgrade, no distress
- 290608: Crack and seat, 8" AC overlay, edge drains
16: Looking south, downgrade, no distress
- 290612: Rubblized, 8" AC overlay, edge drains
17: Level
- 290613: Rubblized, 4" AC overlay
Could be 12" AC overlay
18: Standing on shoulder @ 0+00, upgrade
- 290614: Rubblized, 8" AC overlay
no distress
- 290611: Rubblized, 4" AC overlay, edge drains
Could be 12" AC overlay
19: Marker 27.7-27.8 (county mile marker), near 5+00, mainline and shoulder fatigue, inside curve
- 290605: PCC, maximum restoration, edge drains
20: Near MP 86, exposed PCC
21: North of 280 marker
22: Shoulder distress @ 7+00
- 290601: PCC, control section
23: First joint @ 0+07
24: Station 0+07
- 290602: PCC, minimum restoration
25: Beginning of test section
- 290604: Minimum restoration, 4" AC overlay, saw and seal
26: Looks good

Attendees at Meeting June 3, 1993 Bethany, Missouri

Missouri Highway and Transportation Department

District Maintenance Engineer:

Robert M. Burnett (816) 387 2350
Maintenance and Traffic Division
MHTD
3602 N. Belt Hwy., P.O. Box 287
St. Joseph, MO 64502-0287

Maintenance Area Supervisor:

James (Abe) Robertson (816) 425 8017
MHTD (816) 425 6923
P.O. Box 174
Bethany, MO 64424

Maintenance:

Harold Helton (816) 425 8017

District Materials Office:

Tom Taylor (816) 387 2350

Materials and Research Division:

Bruce Loesch

Materials and Research Field Testing Technician:

Vernon W. Adams (314) 751 2809
MHTD Fax (314) 751 8682
P.O. Box 270
1511 Mo. Blvd.
Jefferson City, MO 65102

Regional Engineer, SHRP.

Richard Ingberg (612) 776 2210
LTPP/FHWA/SHRP Fax (612) 776 7201
1983 Sloan Place, Suite 10
St Paul, MN 55117



MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

Capitol Ave at Jefferson St P O Box 270 Jefferson City MO 65102 (314) 751-2551 Fax (314) 751-6555

Aug 2 *Check G*
Wayne Muri
Chief Engineer

RECEIVED

NO. 151550

SME Plymouth

CTK
C&B
file

October 19, 1993

Richard C. Ingberg
Regional Engineer
North Central Region
Strategic Highway Research Program
1983 Sloan Place
Suite 10
St. Paul, Minnesota 55117-2004

Dear Dick,

The rehabilitation process for jointed reinforced PCC pavement, SPS6, I-35, Clinton county, which has a test area of Break and Seat and a 4 inch asphaltic concrete overlay, exhibits extensive deterioration and failure of the pavement structure.

The area which depicts this failure starts at the beginning of test section 290607 and terminates at the end of test section 290609, this includes all of section 290607, all of section 290609, and all of the test pattern area inclusive. This is a total of 3500 linear feet from the beginning of the transition section which starts section 290607 to the end of the transition section which ends section 290609.

The cause of the pavement's failure may be contributed to many factors:

- 1) The subgrade soil is a silty clay which is a fair to poor subgrade.
- 2) The original contract for the construction of the PCCP included a polyethylene material between the base and the concrete which acted as a barrier that trapped moisture.

Richard Ingberg
Page 2
October 19, 1993

- 3) There is evidence along the edge of the pavement that subgrade material is being pumped to the surface, which is indicative of voids under the pavement.
- 4) The Break and Seat operation did not completely debond the wire mesh reinforcing from the concrete. This may have induced pumping of the fractured slab pieces.
- 5) The test sections are in a vertical curve and during the Break and Seat operation, the fractured slab moved down the grade. This displacement indicates that there was no longer confinement of the fractured slab and discontinuities may have been introduced.

From the 1993 autumnal FWD data, a comparison of the 4 inch overlay of the Break and Seat to the 8 inch overlay of the Break and Seat depicts a range of deflections under the D1 sensor, for a 9 Kip load, of approximately 15 to 30 mils and 5 to 10 mils respectively. The 15 to 30 mils range for the 4 inch overlay is comparable to its pre-overlay condition. This indicates that the 4 inch overlay is contributing little to no structural capacity to the pavement.

Since the 8 inch overlay has lower deflection values and does not exhibit any signs of distress or failure, an additional 4 inches of asphaltic pavement would be a minimum to arrest the deterioration of the pavement. To lower the deflection values into the range of the 8 inch overlay, it would most probably take an overlay of 6 to 8 inches.

Therefore, it is our recommendation to our district office that the rehabilitation of the 3500 feet in question should be performed by first repairing all failed areas with full depth asphaltic patching immediately followed with a 6 inch overlay. This rehabilitation should be performed before the pavement deteriorates to the point where MHTD maintenance crews have a difficult time keeping up with its deterioration and there is still some structural value of the existing 4 inches of asphalt concrete.

Richard Ingberg
Page 3
October 19, 1993

Since this rehabilitation process will alter the structure of the pavement section, the section will no longer be in the same experimental cell. MHTD would like to request from SHRP that these sections will be allowed to stay in the SPS-6 test site as revised test sections. MHTD will continue to monitor and collect data after the rehabilitation process.

Very truly yours,

Bill Trimm

Bill Trimm, Division Engineer
Materials and Research

rn/dc

cc: Garry Chegwidden-1



LONG TERM PAVEMENT PERFORMANCE

North Central Region

1983 Sloan Place, Suite 10, St. Paul, MN 55117
Tel (612) 776-2210 Fax (612) 776-7201



RICHARD C. INGBERG
LTPP Regional Engineer

November 10, 1993

CTV
FBI
File

William Trimm
Division Engineer, Materials & Research
Missouri Hwy & Transportation Department
Capitol Avenue at Jefferson Street
P.O. Box 270
Jefferson City, MO 65102

Bill
Dear Mr. Trimm:

We agree with your letter of October 19, 1993 to overlay test section 290607 through test section 290609 for a total of 3500 linear feet. As you know, we have been watching this pavement deteriorate since June of this year and agree that rehabilitation needs to be done. We also agree with your recommendation that the rehabilitated sections should remain in the SPS-6 test project as revised sections. We will continue to work with you to monitor and collect data after the rehabilitation process.

Bob Girard and I discussed your recommendation last week and were in total agreement. We may need rehabilitation on other test sections over the next several years. We appreciate the diligence and cooperation you and your staff along with the maintenance staff in watching over this project. We will remark the sections and begin monitoring as soon as our schedule permits.

Sincerely,

Dick

Richard C. Ingberg
Regional Engineer

cc:	Paul Teng	Monte Symons
	Shiraz Tayabji	John Miller
	Starr Kohn	Gene Skok
	Chuck Gemayel	Ann Johnson

APPENDIX E
ASPHALT CEMENT CONCRETE MIX DESIGNS



MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT - DIVISION OF MATERIALS AND RESEARCH
ASPHALTIC CONCRETE TYPE 1B

JOB ID # J110507

PROJECT# I-IRG-35-2(60), A & B

ROUTE# I-35

COUNTY= Davis-Harrison

DATE# 5/27/92

PRODUCT CODE / FACILITY CODE / PRODUCER-LOCATION

| IDENT. | SP. GR | ASR | FORMATION /

LEDGE / % CHERT

1002C1ACLS / 1030617111 / Martin Marlette #171, Pattenburg, MO 92- 3059 2.667 1.3 Both. Falls / 9-13

1002C2ACLS / 3030617111 / Martin Marlette #171, Pattenburg, MO 92 3050 2.672 1.4 Both. Falls / 9-13

1002K2ACCLS / 3030617111 / Martin Marlette #171, Pattenburg, MO 92- 3051 2.700 Both. Falls / 9-13

1002M1ACMS / 3006400414 / Capital #4, Lexington, MO 92- 2912 2.642 Mo. River

1002H1ACHL / 3001704018 / Ash Grove Cement, Springfield, MO 92- 1513 2.235 Hyd. Lime

1015ACVG..0200 / 3042000226 / Shell, K. C., MO/Hood River, IL 92- 449 1.036 AC-20

MATERIAL 92 92 92 92 | | 92 92 92 92

IDENT. 3059 3050 3051 2912 1513 | | 3059 3050 3051 2912 1545

92080 PERCENT 30.0 31.0 24.0 14.0 1.0

1" 100.0 100.0 100.0 100.0 | | 30.0 31.0 24.0 14.0 1.0

3/4" 91.0 100.0 100.0 100.0 | | 27.3 31.0 24.0 14.0 1.0

1/2" 19.0 93.0 100.0 100.0 | | 5.7 28.6 24.0 14.0 1.0

3/8" 5.0 70.0 100.0 100.0 | | 1.5 21.7 24.0 14.0 1.0

#4 2.0 26.0 100.0 100.0 | | .6 6.1 24.0 14.0 1.0

#8 1.0 5.0 90.0 97.0 100.0 | | .3 1.6 21.6 13.6 1.0

#16 1.0 2.0 52.0 89.0 100.0 | | .3 .6 12.5 12.5 1.0

#30 1.0 2.0 27.0 65.0 100.0 | | .3 .6 6.5 9.1 1.0

#50 1.0 2.0 13.0 32.0 99.5 | | .3 .6 3.1 4.5 1.0

#100 1.0 2.0 0.0 8.0 99.5 | | .3 6 1.9 1.1 1.0

#200 .0 1.5 6.4 3.3 99.0 | | .2 .5 1.5 .5 1.0

LABORATORY 17.10 D= 2.491 - X VOID= 3.93 FILM

CHARACTERISTICS D5/8d= 2.393 V.M.A.= 14.32 THICK.= 10.2 MIN. AGG. 95.5 %

ASHTO T-245 FSTABIL= 2211 FILLED= 72.6 -200/AC= 0.0 ASPHALT CONTENT 4.5 %

CALIBRATION NUMBER = 200046 MASTERS GAUGE BACKGROUND COUNT = 2226 CURVE COEFFICIENTS - A1 = 5.072213

MASTER GAUGE SERIAL NO = 770 SAMPLE WEIGHT = 7850 - A2 = 3.457570

SINCE

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT - DIVISION OF MATERIALS AND RESEARCH
ASPHALTIC CONCRETE TYPE 1C

JOB NO - J110507

PROJECT# 1-140-35-2(60), A & B

ROUTE# I-35 COUNTY= DeSoto-Harrison DATE= 5/11/92

PRODUCT CODE / FACILITY CODE / PRODUCER-LOCATION	IDENT. #	SP. GR.	ABS	FORMATION / LOGES / X CHEAT
1002ZACLS / 303061711 / Martin Marietta #171, Pottersburg, MO	92- 3060	2.672	1.6	Beth. Falls / 9-13
1002MACHSL / 303061711 / Martin Marietta #171, Pottersburg, MO	92- 3051	2.700		Beth. Falls / 9-13
1002FAACH / 3006400414 / Capital #4, Lexington, MO	92- 2912	2.642		No. River
1002FLACHL / 3001704018 / Ash Grove Cement, Springfield, MO	92- 1543	2.235		Hyd. Lime

1015ACVG. 0200 / 3042000326 / Shatt, K. C., Woodland River, IL				92- 449	1.034	AC-20
MATERIAL	92	92	92			
IDENT.	3060	3051	2912	1543		
					92071	
				PERCENT	71.0	16.0
"					12.0	1.0
"						GRAD

3/4"	100.0	100.0	100.0	100.0				
1/2"	93.0	100.0	100.0	100.0				
3/8"	70.0	100.0	100.0	100.0				
#4	26.0	100.0	100.0	100.0				
#8	5.0	90.0	97.0	100.0				
#16	2.0	52.0	89.0	100.0				
#30	2.0	27.0	65.0	100.0				
#50	2.0	13.0	32.0	99.5				
#100	2.0	7.0	8.0	99.5				
#200	1.5	6.4	3.3	99.0				

LABORATORY	MPD	2.461	X WODS	- 4.11	FILM	HDX COMPOSITION
CHARACTERISTICS	D ₅₀	2.379	V.M.A. =	15.07	THIX. = 11.6	XIN. AGG. 95.2 %
ASHTO T-245	STABIL.	1964	XTRIFID	72.7	-200/ACG = 0.7	ASPHALT CONTENT 4.8 %
CALIBRATION NUMBER	=	20050	MASTER GAUGE BACKGROUND COUNT =	2153	DRIVE CROFFICIENT = A1	= 5.190049
MASTER GAUGE SERIAL NO.	=	770	SAMPLE WEIGHT	7700	A2	= 3.278167

SITE